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MALLET ARTICULATED COMPOUND LOCOMOTIVE, TYPE 2 6-6 2.

GREAT NORTHERN RAILWAY.

The Great Northern Railway has recently received an order of five Mallet articulated compound locomotives from the Baldwin Locomotive Works, which have the distinction of being the heaviest locomotives in the world. They have a total weight of 355,000 lbs., of which 316,000 lbs. is on the drivers.

The satisfactory service given by the locomotive of this type on the Baltimore & Ohio R. R. during the past twenty months has proved the practicability of this monster machine for service under the most difficult conditions of grade and curvature. Mr. Muhlfeld, general superintendent of motive power of the Baltimore & Ohio Railroad, in his paper on "Large Steam and Electric Locomotives," delivered before the New York Railroad Club, February, 1906, stated that, "from the performance up to the present date (one year) it has been found that the following features embodied in the design of this locomotive have given entirely satisfactory results with respect to design, maintenance and operation: Flexible joints to the high and low-pressure cylinders. Receiver and exhaust pipes. Articulated frame. Intercepting, reducing and emergency valves. An intermediate chamber system of compounding and simpling. Combination hand and power reversing gear. Walschaert valve motion. Method of securing high-pressure cylinder to boiler. Tracking and riding qualities, going forward or backward around maximum curvature and when pushing, pulling or braking trains or running light. There has been no trouble on account of priming, and the results accomplished through the distribution of work over four instead of two main crank pins and auxiliary parts have been markedly satisfactory."

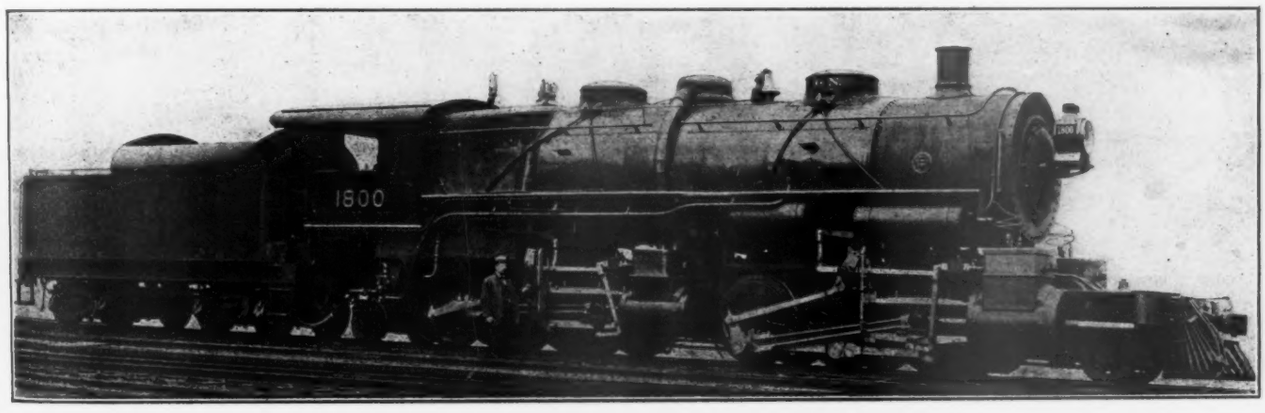
It was found that this locomotive would haul a heavier train over the same grades than two consolidation locomotives, which together (including tenders) weighed nearly 200,000 lbs. more than the Mallet engine.

The Great Northern engines differ from the one on the Baltimore & Ohio, which was very thoroughly illustrated and described in this journal in 1904 on pages 167, 237, 262 and 279, and in 1905 on pages 229 and 249; in the addition of leading and trailing trucks, type of boiler, and in many of the details.

By reference to the following table of the comparison of a few of the important dimensions and ratios it will be seen that while the Great Northern engines are greater in total weight they are somewhat less on drivers, and give a weight per axle of 26⅛ tons, as compared with 27⅞ tons. The steam pressure is 200 lbs. instead of 235, but this is more than equalized by the larger cylinders, so that the theoretical tractive effort, also increased by the 1-in. difference in diameter of drivers, is greater than on the earlier example.

Road	G. N.	B. & O.
Builder	Baldwin	American
Wheels	2-6-6-2	0-6-6-0
Total weight	355,000 lbs.	334,500 lbs.
Weight on drivers	316,000 lbs.	334,500 lbs.
Size, cylinders	21½&33x32 ins.	20&32x32 ins.
Diameter of drivers	55 ins.	56 ins.
Tractive effort	71,600 lbs.	70,000 lbs.
Steam pressure	200 lbs.	235 lbs.
Total wheel base	44 ft. 10 ins.	30 ft. 8 ins.
Driving wheel base, rigid	10 ft.	10 ft.
Total heating surface	5,658 sq. ft.	5,600 sq. ft.
Grate area	78 sq. ft.	72.2 sq. ft.
Weight on drivers ÷ tractive effort.	4.41	4.78
Total weight ÷ total heating surface	62.8	59.9
Weight on drivers ÷ total heating surface	56	59.9
Tractive effort x diam. drivers ÷ total heating surface	697	700
Total heating surface ÷ vol. equiv. simple cylinders	271	295
Grate area ÷ vol. equiv. simple cylinders	3.75	3.85

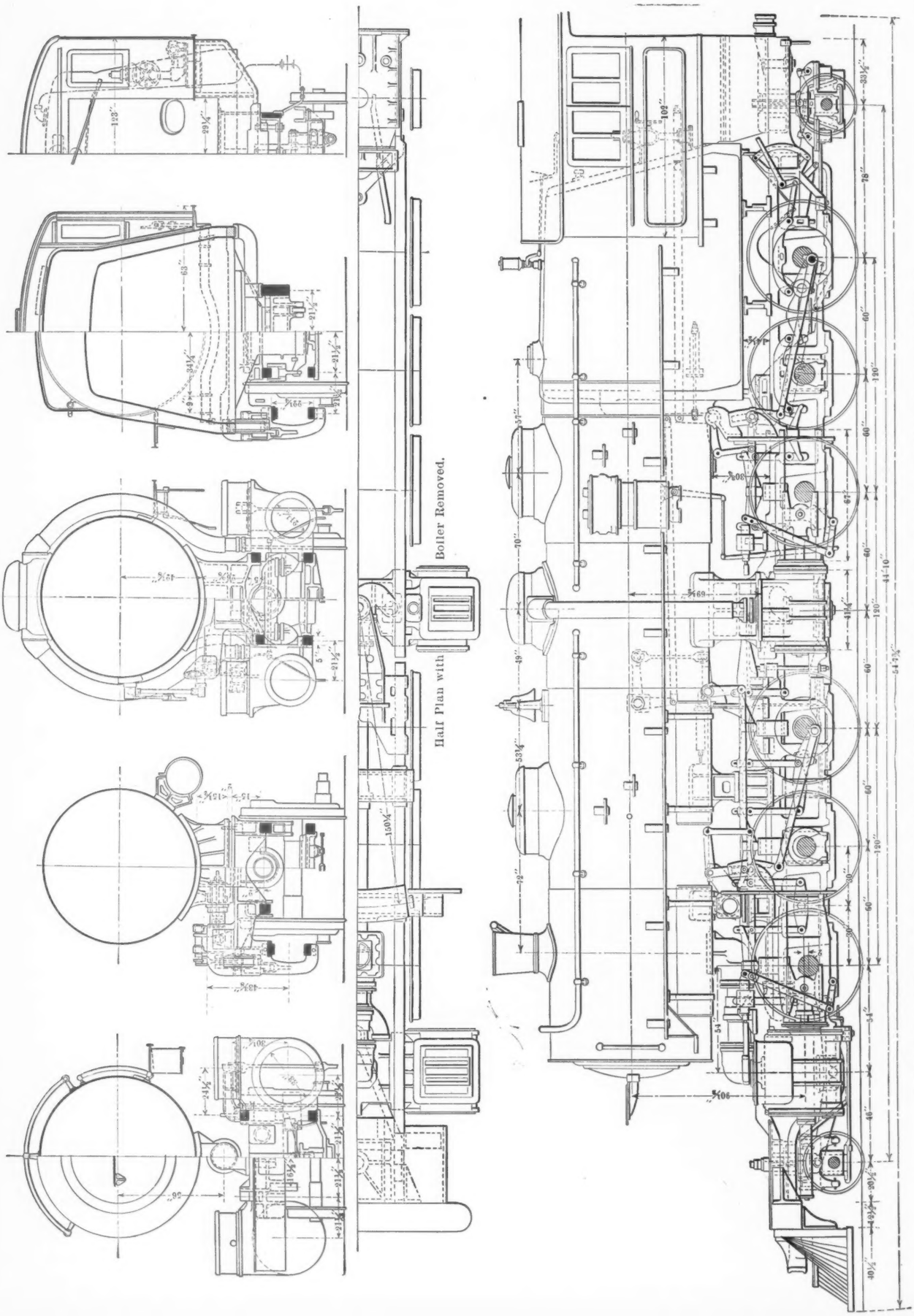
As regards the general size and capacity of the boiler the two locomotives are very nearly alike, the Great Northern engine, however, has the Belpaire type of firebox, while the radial stay design is used on the Baltimore & Ohio engine. They both have practically 5,600 sq. ft. of heating surface, the Great Northern engine having 21-ft. flues while the Baltimore & Ohio engine has flues 20 ft. 10¾ ins. long. The grate area in the later design has been made 78 sq. ft. instead of 72.2. These differences, in which the boiler on the Great Northern exceeds that on the Baltimore & Ohio, together with a smaller weight on drivers, affects the ratios to some slight extent, as will be seen in the table.



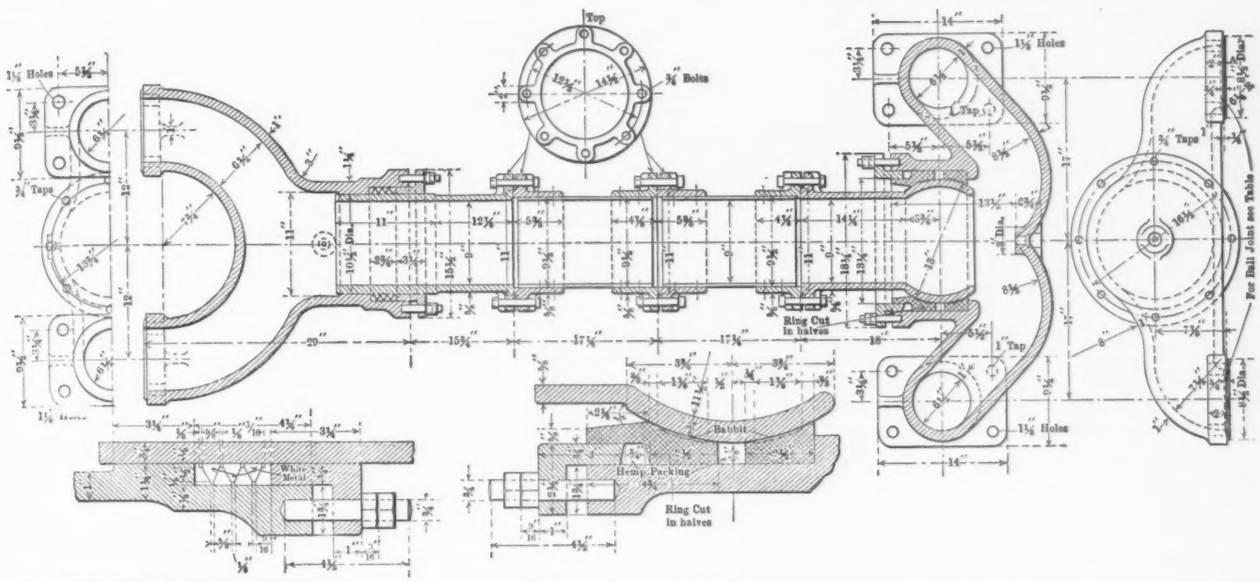
HEAVIEST LOCOMOTIVE—GREAT NORTHERN RAILWAY.

The boiler of the Great Northern engine measures 84 ins. at the front ring, and has the waist made up of three rings. The circumferential seam in the front of the dome is triple riveted, the others being double riveted. The horizontal seams have diamond welt strips. The back head of the Belpaire firebox is sloping, and the very short throat sheet is made vertical, the mud ring being horizontal. The water spaces around the firebox are large, measuring 6 ins. in front and 5 ins. on the sides and back at the mud ring, which space is gradually increased toward the crown sheet. The flues are spaced with ¾-in. bridges.

The dome, which because of clearance limits is built very low, is made in the form of a single steel casting; it is fitted with a Rushton throttle, which has two steam outlets, one on either side, and takes steam from the top only. The illustration showing the cross section of the dome makes this construction clear. The throttle chamber connects to bosses on the dome casting, with ball joints, and the steam passage is continued outward to steam pipes, which pass outside of the boiler shell to the high-pressure cylinders located directly below the dome. These outside pipes are heavily lagged, and connect to the dome and cylinder castings with the usual ground joints.

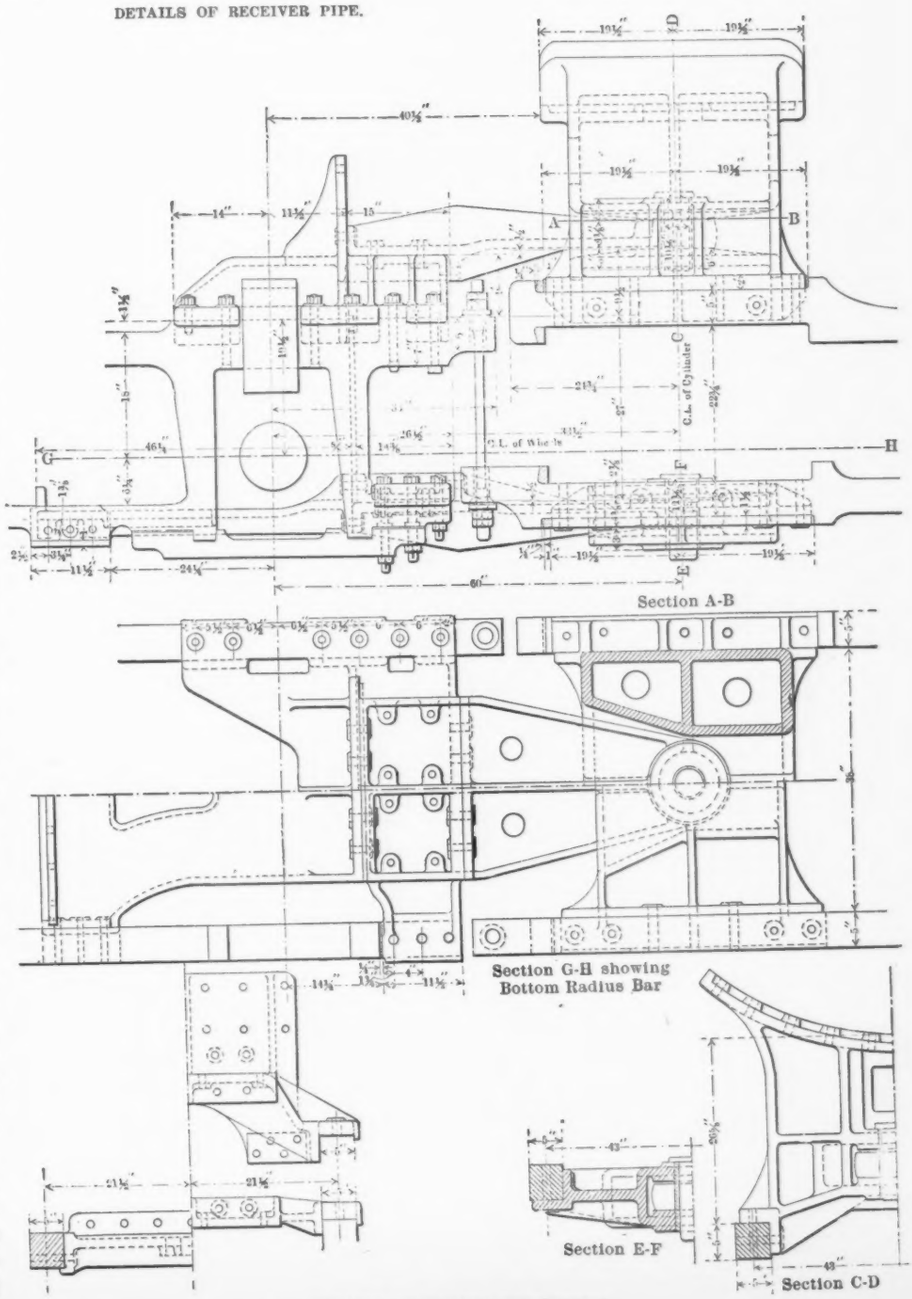


MALLET ARTICULATED COMPOUND LOCOMOTIVE, 2—6—6—2 TYPE—GREAT NORTHERN RAILWAY.

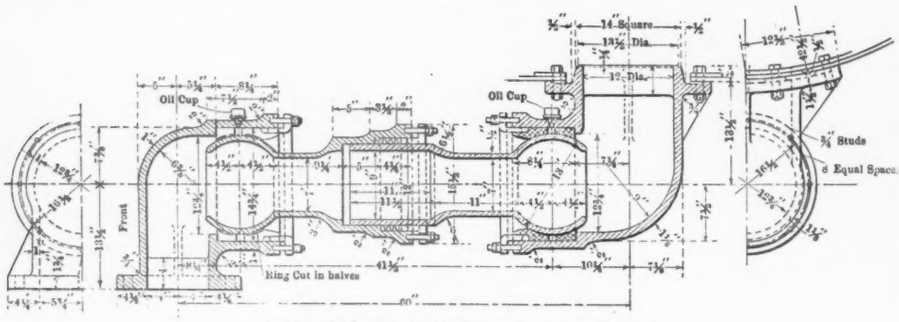


DETAILS OF RECEIVER PIPE.

The frames of both the front and rear section are of cast steel, 5 ins. wide and about 7 ins. deep at the pedestals. The two sections are connected together by a hinge joint, the details of which are shown in one of the illustrations. It will be seen from the general elevation that the center of this connection is equally distant from the center of the front axle of the rear engine and the rear axle of the front group. Connections are made from both the upper and lower rails of both sets of frames. The upper connection on the rear group is made in the saddle which supports the boiler at the high-pressure cylinders, but does not form part of the cylinder castings. It rests upon and between the upper rails of the frame, and is of the usual saddle appearance. A passage is cored longitudinally through its center, into which the radius bar from the front group reaches and hinges around a pin in the center. A similar connection on the lower frame is made by a heavy cast steel cross tie extending across and beneath the lower rails, and securely bolted thereto by five vertical and two horizontal bolts in each rail in addition to keys. The upper radius bar is of cast steel, with deep webs on the sides and in the center. It is fastened to a very rigid casting extending across and lipping over the top of the upper rails of the front frames, to which it is fastened by six vertical bolts in each rail. The radius bar fastens to this casting by both vertical and horizontal bolts, as shown in the illustration. The lower connection is made in a similar manner, with the exception that the space back of the pedestal is not wide enough to give a secure support for the cross tie, and an auxiliary casting has been fastened across the frames ahead of the ped-



DETAILS OF FRAME CONNECTION.



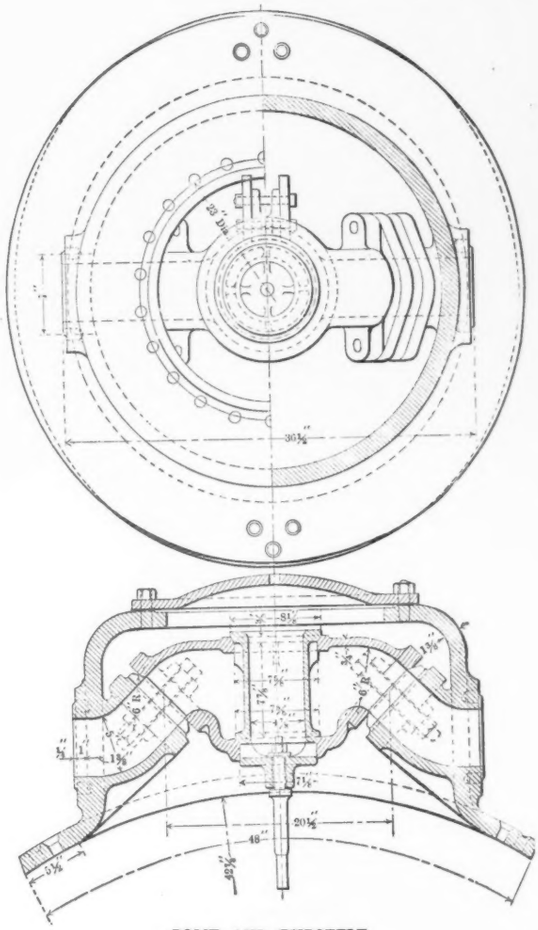
LOW-PRESSURE EXHAUST PIPE CONNECTION.

estal and extends backward, connecting to the cross tie. The hardened pins forming the hinge are 4 ins. in diameter and the holes are bushed.

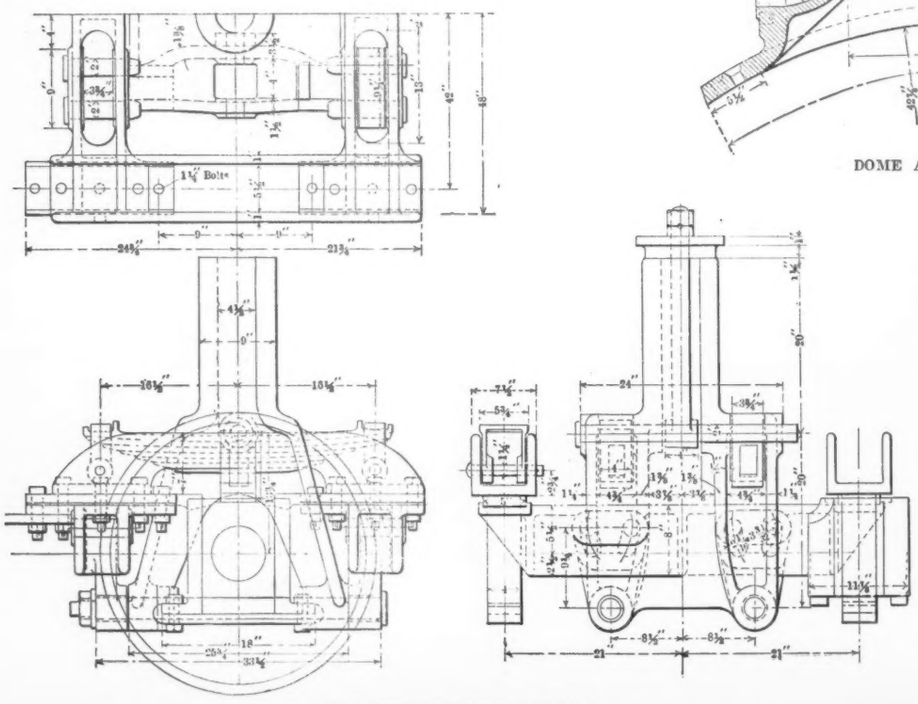
It will be noticed that the upper rails of the front group and the lower rails of the rear overlap each other, and that a vertical bolt joins these two projections. Since these frames will have a horizontal movement relative to each other, this bolt is provided with washers resting in balled seats in the frames, and the bolt itself has no side bearing in the frames. Its purpose is to equalize the weights at this point and prevent binding in the hinge or articulated connection.

The boiler is carried on the front set of frames by a support formed by a heavy steel casting across the upper rails of the frame between the two rear drivers and a saddle on the boiler shell which extends down and takes the bearing through a cast iron shoe. This bearing is designed to carry the whole weight of the front end of the boiler while still allowing free movement in the horizontal plane both for movement of the front group of wheels and expansion of the boiler. Just ahead of it is a spring centering device for bringing the front engine into line after leaving a curve, which will also help carry the weight of the boiler under unusual conditions. This consists of a casting across the upper rails of the frame, which also acts as a support for the guide yoke, and a radial saddle casting on the boiler shell. Two heavy coiled springs are arranged in the saddle, one on either side, and so connected to the casting on the frames that whenever the front group moves to one side the spring on that side will be put in compression.

The high-pressure cylinders are cast without saddles, and are bolted and keyed to the upper and lower rails of the rear set of frames. The steam enters from the outside steam pipe, which connects just inside of the valve chest, and passes through cored passages to the valve. It exhausts from an opening on the inside, between the frames, into the receiver pipe, which extends forward between the frames to the low-pressure cylinders. This receiver pipe is shown in one of the illustrations, and it can be seen that it has a ball joint, whose center is in exact line with the center of the articulated connection. It is made up of five



DOME AND THROTTLE.



SIDE BEARING RADIAL TRUCK.

sections, the rear one being of cast steel and forming the ball joint; the two main sections are of heavy wrought iron pipe, with heavy flanges on each end for connecting to the adjoining sections; the fourth section forms the inner member of the slip joint and is of cast steel, while the fifth section is in the shape of a Y, forming the outside of the slip joint, and makes connections at the rear of the low-pressure cylinder saddle. The seats for the ball joint are of brass faced with babbitt, and between them is a space 1 in. wide which is packed with hemp. At the slip joint the packing is of white metal rings.

VIEW IN CAB OF MALLET COMPOUND LOCOMOTIVE—GREAT NORTHERN RAILWAY.

The receiver pipe is supported at several points by angle-iron loops hung from the frame cross braces and by the vertical frame stiffening plate placed just back of the rear pedestals of the front group, through which it passes.

The low-pressure cylinders join at the center line of the engine, and the exhaust is carried to the front end by a pipe having a ball joint at either end and a slip joint in the center, the detail of which is shown herewith.

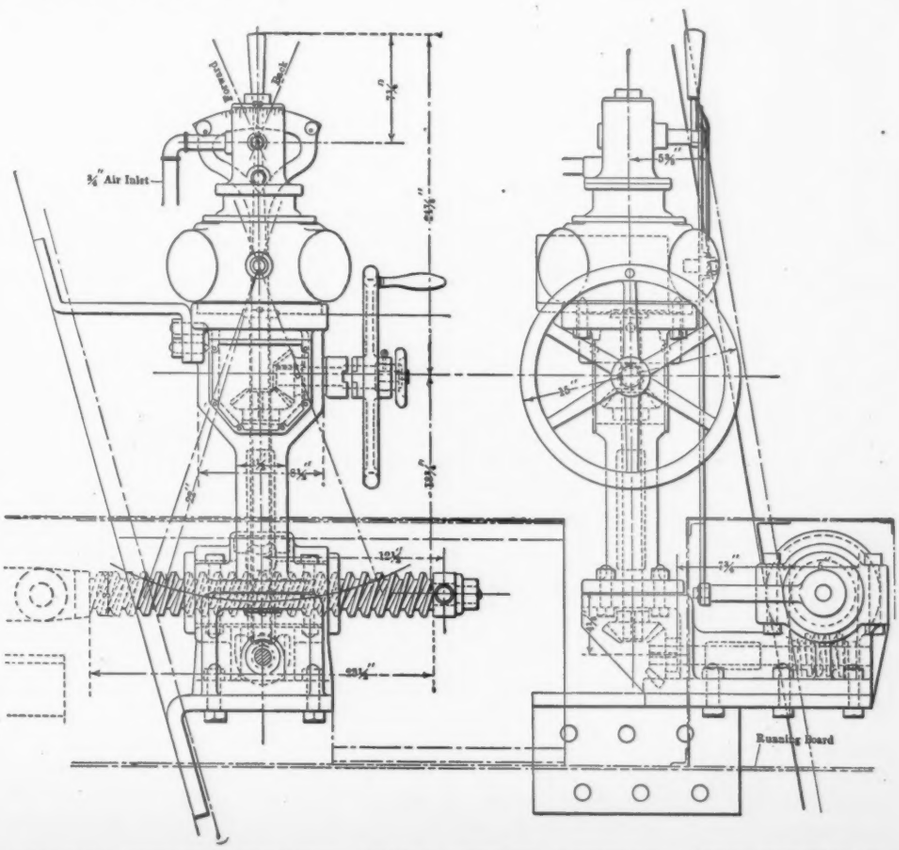
Special attention was given in the cylinder castings to separating the entering and the exhaust steam passages by an air space at all points. Balanced slide valves are used on both cylinders, both operated from the Walschaert type of valve gear. The receiver pipe is very heavily lagged, as is also the exhaust connection. The oil pipe connections to the low-pressure cylinders have several turns of large radius, making a flexible connection to allow for a considerable movement relative to the boiler. There is an auxiliary hand oil device on each low-pressure steam chest in case the oil pipes break.

There is no intercepting or reducing valve employed in this design, and the only starting device is a 1¼-in. pipe which connects into the receiver and has a valve in the cab, by means of which a small amount of high-pressure steam can be admitted to this pipe, principally for the purpose of preventing vacuum, although if left open long enough it will increase the pressure on the low-pressure pistons at slow speeds and in starting.

The front engine truck is of the usual radial design, with swing links and center bearing, but in the rear truck a special construction with side bearings has been used, which is shown in one of the illustrations. Reference to the general drawing will show that the two equalizers extending from the rear driving spring hangers are set diagonally inward and rest in the two swing links supported on a 2-in. pin passing through the pivot casting of the rear truck. This casting extends downward on either side of the axle with four legs, which connect to the lower end of four heart-shaped hangers. Each of these have their upper bearings on two pins in the cross ties of the truck frame. These cross ties connect the truck side frames of the pedestal type. The hangers of the elliptical spring over each journal box are fastened at these connections. The radius bar is connected to the truck frame.

It will be noticed that there is a bell crank on the boiler shell, just above the high-pressure cylinders, which forms part of the reversing mechanism of the valve gear. This crank is for the purpose of providing a hinge connection in the valve gear as near as possible to the articulated frame joint, so as to prevent the movement of the front group of wheels from distorting the movement of the valve. For clearance reasons it was necessary to make the connection to the radius bar of the rear valve motion ahead of the link, while that in front connects behind it. This difference in movement is equalized by the connection to the rear lift shaft, which gives the reach rod extending forward for the front valve gear a longer arm than that extending back into the cab.

The impossibility of handling two complete sets of very heavy valve gear with the ordinary reverse lever is easily understood, and for this purpose a type of power-reversing mechanism, which is known as the McCarroll, has been designed, and is shown in one of the illustrations. This device operates by air ordinarily, although a steam connection has been provided, and consists briefly of a rotary air engine driving a vertical shaft, which connects through beveled gears to a horizontal worm shaft. This worm operates a threaded



M'CARROLL REVERSING MECHANISM, MALLET COMPOUND LOCOMOTIVE—GREAT NORTHERN RY.

nut or bushing around the threaded end of the reach rod. The operation is controlled by a small handle, which moves a slide valve and admits air to operate the air engine in either direction. The handle is automatically brought to a closed position when the full gear point has been reached, and an indicator is provided which shows the position of the gear on a small quadrant. This gear is able to completely reverse the engine in three seconds. A hand wheel is provided for operating it in case of an emergency.

Two non-lifting injectors of extra large size are used.

The general dimensions, weights and ratios follow:

MALLET ARTICULATED COMPOUND LOCOMOTIVE.

GREAT NORTHERN RAILWAY.

GENERAL DATA.

Gauge	4 ft. 8½ ins.
Service	Freight
Fuel	Soft Coal
Tractive effort	71,600 lbs.
Weight in working order, est.	355,000 lbs.
Weight on drivers, est.	316,000 lbs.
Weight on leading truck, est.	19,000 lbs.
Weight on trailing truck, est.	20,000 lbs.
Weight of engine and tender in working order	503,000 lbs.
Wheel base, driving, each group	10 ft.
Wheel base, total	44 ft. 10 ins.
Wheel base, engine and tender	73 ft. 2¼ ins.

RATIOS.

Weight on drivers ÷ tractive effort	4.41
Total weight ÷ tractive effort	4.96
Tractive effort x diam. drivers ÷ heating surface	698
Total heating surface ÷ grate area	72.5
Firebox heating surface ÷ total heating surface per cent.	3.9
Weight on drivers ÷ total heating surface	55.85
Total weight ÷ total heating surface	62.75
Volume equivalent simple cylinders	20.82 cu. ft.
Total heating surface ÷ vol. equivalent cylinders	271
Grate area ÷ vol. equivalent cylinders	3.75

CYLINDERS.

Kind	Compound
Diameter and stroke	21½ and 33 x 32
Valves	Balance slide

WHEELS.

Driving, diameter over tires	55 ins.
Driving, thickness of tires	3½ ins.
Driving journals, diameter and length	10 x 12 ins.
Front truck wheels, diameter	30 ins.
Front truck, journals	6 x 12 ins.
Trailing truck wheels, diameter	30 ins.
Trailing truck, journals	6 x 12 ins.

BOILER.

Style	Belpaire
Working pressure	200 ins.
Outside diameter of first ring	84 ins.
Firebox, length and width	117 x 96 ins.
Firebox plates, thickness	⅜ and ½ in.
Firebox, water space	F. 6, S. & B. 5 ins.
Tubes, number and outside diameter	441-2¼ ins.
Tubes, length	21 ft.
Heating surface, tubes	5,433 sq. ft.
Heating surface, firebox	225 sq. ft.
Heating surafce, total	5,658 sq. ft.
Grate area	78 sq. ft.
Centre of boiler above rail	120 ins.

TENDER.

Tank	Water bottom
Frame	Steel
Wheels, diameter	36 ins.
Journals, diameter and length	5½ x 10 ins.
Water capacity	8,000 gals.
Coal capacity	13 tons

ERIE HOSPITAL CAR.—The Erie Railroad has recently added a 60-ft. hospital car to its equipment. The operating room is 15 ft. 10 ins. long and has a modern operating table and a full equipment of surgical instruments and supplies. Four-foot sliding doors on either side, with portable steps, permit an easy entrance with a stretcher. The room has six side windows, two windows in each door and a large window in the roof above the operating table. The inside finish is of composite board, made especiaally for this purpose, covered with white enamel paint. The floor is covered with white rubber tiling. The ward room, 43 ft. 4 ins. in length, is connected to the operating room by two sliding doors with ground glass windows. It is equipped with eleven brass beds, a lavatory and a saloon. The floor and inside finish is the same as that in the operating room, and white rubber curtains are used between the beds. Several ground glass windows, fitted with white rubber roller curtains, are provided on each side of the room. Supplies of all kinds are carried in equipment boxes underneath the car. Six-wheel trucks are used.

THE SURCHARGE PROBLEM.

BY C. J. MORRISON.

Every railroad is to a great extent a manufacturer, as various articles for locomotives, cars, stations, etc., are made in their shops. Great ignorance usually exists as to the actual cost of these articles. Some companies call the bare price of labor and material the cost, while others add an estimated surcharge ranging from 20 to 60 per cent. It is hardly fair to the railroad or to the outside manufacturers to compare these prices with the selling price of the same articles in the market. In some instances the railroad is losing money by buying articles which it should manufacture, while in others it loses by manufacturing articles which should be purchased. I believe, it is safe to say, that not over one railroad in the United States knows the exact surcharge in each department.

The surcharge may be divided into two distinct sections, first, the money surcharge, and second, the book surcharge. The money surcharge consists of the wages paid for supervision, accounting, drafting room, stationary engineers, firemen, electricians, etc. The book surcharge consists of taxes, interest on investment, depreciation of buildings and machinery, etc.

The surcharges in a modern railway repair shop will classify about as follows:

1. Rent.
   - A. Depreciation of Buildings—4 per cent. per annum.
   - B. Interest on Buildings—4 per cent. per annum.
   - C. Interest on Land—4 per cent. per annum.
   - D. Repairs to Buildings—Material and Labor.
   - E. Insurance.
   - F. Taxes.
2. Supervisory and Miscellaneous.
   - A. Superintendence and Office.
   - B. Accounting.
   - C. Drawing Room.
   - D. Spoiled Work.
   - E. Laborers and Watchmen.
3. Machinery.
   - A. Depreciation per annum 10 per cent.
   - B. Interest per annum 4 per cent.
   - C. Repairs (Labor).
   - D. Repairs (Material).
   - E. Replacing Small Tools.
   - F. High Speed and Other Steels.
   - G. Supplies.
4. Power, Heat, Light, Water, etc.
   - A. Depreciation per annum 4 per cent. } on Buildings.
   - B. Interest per annum 4 per cent. }
   - C. Depreciation per annum 10 per cent. } on Machinery.
   - D. Interest per annum 4 per cent. }
   - E. Wages.
   - F. Fuel.
   - G. Repairs.
   - H. Supplies.
   - I. Lamps, Coal Delivery, etc.

These items expressed as a percentage of the pay roll are found to average for a number of shops as follows:

	Loco. Dept.	Car Dept.	Total.
Rent	11.5	8.1	10
Supervision and Misc.	13.8	12.0	13
Machinery	26.6	14.4	21
Power	8.1	3.5	6
Total	60.0	38.0	50

The next step is to determine the surcharge for each department. It will not do to apply the flat 60 per cent. surcharge to any work in the locomotive department regardless of where it is performed. The surcharge on bench work and on machine work is entirely different. The surcharge for any department is found by determining the exact proportion of each charge which this department bears. These charges are found to vary in the different departments of one locomotive shop from 40 to 220 per cent.

We are now in a position to determine the exact cost of each article produced, and come to a logical conclusion as to whether we should buy or manufacture any given article. For example, suppose an article manufactured in the tin shop costs as follows:

Material	$0.85
Labor	1.25
Surcharge, 40 per cent.	.50
Total	$2.60

We now know, beyond the shadow of a doubt, whether to buy or manufacture this article, as the decision hinges on whether the price is below or above $2.60.

In one shop where an exhaustive study of the surcharge

was made, articles which had formerly been manufactured are now purchased, while articles which had been purchased are now manufactured with a great saving to the company.

Another very important use that may be made of the surcharge study is to determine whether or not certain machines are profitable. In order to do this it is necessary to divide the surcharges into "machine charges" and "labor charges." The machines in the locomotive department will carry as much of charge 1 as they occupy buildings and grounds, probably half, about 10 per cent. of charge 2B, about 80 per cent. of charge 3, except 3E which goes on labor, and about 82 per cent. of charge 4. Probably the easiest and most practical way to handle this machine surcharge is as an hour rate on the machines. That is a machine will be rated at so much per hour just the same as a workman. To determine the rate on any machine, determine the total machine charge in the department in which the machine is located and express it as a per cent. of the total valuation of the machines, then determine the number of hours per year which the machine in question runs. Assume for example a machine whose valuation is $1,200 located in a department where the machine surcharge is 90 per cent. The machine must then earn 90 per cent. of $1,200 or $1,080 per year. Assume the machine runs 3,000 hours per year. It must then earn $0.36 per hour and that amount is its hour rate. The portion of the surcharge carried by the man will still be expressed as a per cent. of his wages, but will, of course, be much lower than in the case where the total surcharge is carried by the man.

A glance at the surcharge problem shows at once the importance of keeping the machines running, and of not doing work on a high-priced machine, which can be done in almost as short a time on a cheaper machine. It also shows that some classes of work may be done by hand cheaper than on a machine which will only run a few hours a year. A few months ago an energetic salesman offered for sale to a railroad a wonderful labor saving machine. It looked good, but, admitting it could do all the salesman claimed, it could not even earn its surcharge because it could not be kept busy. As an excellent example of this sort of thing take an old machine valued at $4,000 and whose hour rate is $0.70. A $3.00 man runs this machine and it requires three hours to complete a certain job. The cost is then:

Labor, 3 hours at $.30	$0.90
Labor surcharge, 90 per cent.	.81
Machine charge, 3 hours at $.70	2.10
Total	$3.81

Two of these machines are required to handle the work of the shop running 2,700 hours a year each. A machine advertised to do this work in 1 hour would cost, installed ready to run, $12,000. As this machine would run only 1,800 hours per year, its rate would be $3.00 per hour. The job would then cost:

Labor, 1 hour at $.30	$0.30
Labor surcharge, 90 per cent.	.27
Machine charge, 1 hour at $3.00	3.00
Total	$3.57

The savings on each job would therefore be $0.24 or $432 per year, which is 3.6 per cent. on the investment of $12,000. The investment would therefore be a good one as the machine, would not only pay its surcharges but also earn a profit of 3.6 per cent.

Another and very important question which comes up with the surcharge study is the problem of reducing costs. A careful study will show that in many cases costs may be greatly reduced by raising wages and demanding a greater output. Assume a man rated at $0.25 per hour running a machine whose rate is $0.60 per hour, and taking 5 hours to do a job. The cost is then:

Labor, 5 hours at $.25	$1.25
Labor surcharge, 60 per cent.	.75
Machine charge, 5 hours at $.60	3.00
Total	$5.00

Suppose the man's wages are raised to $0.30 per hour or another man is employed and the time for the job is reduced to 4½ hours. The cost is:

Labor, 4½ hours at $.30	$1.35
Surcharge, 60 per cent.	.81
Machine charge, 4½ hours at $.60	2.70
Total	$4.86

This change in time required, from 5 to 4½ hours, is not unusual. A cut of 50 per cent. in time on a job has often been effected by a 20 per cent. increase in wages.

The great mistake is often made of considering the pay roll, as the one great item which must be watched, and of paying no attention to the surcharges. This is a serious and sometimes a fatal mistake. The surcharges are just as real as the pay roll, and great savings may be effected by reducing the surcharges even if it is accomplished by raising wages. A cut in the surcharges never causes a strike or discourages the workmen.

THE ARTICULATED LOCOMOTIVE.—Heretofore the locomotive has grown generally in size and weight, without radical change in principle to meet conditions of growth which cannot properly be made through the application of the brute strength idea in design. Large freight locomotives of ordinary types now involve single parts so large as to be difficult to handle in the shop. Their very size gives evidence of the stresses to which they are subjected, and it is believed that the time has arrived for dividing the power and work of the freight locomotive into a larger number of parts, as is done in the case of the Mallet articulated compound, which has now been successfully running for over a year on the Baltimore & Ohio Railroad. This locomotive weighs 477,500 lbs., including tender, and is the heaviest and most powerful ever built. A glance at this enormous machine immediately indicates the absurdity of designing it upon the basis of two cylinders. This locomotive has operated so successfully as to practically establish the principle of the articulated compound for locomotives which are not nearly so heavy. This general subject of the large freight locomotive is one which now needs, and will continue to need, the attention of those who are preparing to deal with the problems of the next few years—*Mr. G. M. Basford, at Purdue University.*

COOLING AND VENTILATING THE NEW YORK SUBWAY.—The arrangements for cooling and ventilating the subway in New York City have been practically completed. At the Brooklyn Bridge Station the air will be cooled by water coming from four wells 45 ft. deep. The water is forced through two cooling coils, one on each side of the station, each consisting of 4½ miles of 1-in. pipe and capable together of cooling 150,000 cu. ft. of air 15 deg. a minute. Two fans are provided on each side of the station for driving the air over the coils and forcing it through large galvanized iron ducts of rectangular section, which run along the platforms. Square vents are cut at intervals. In addition to the plants which cool the air by the use of water pipes, ventilation will be secured by a system which will renew the air throughout the subway every 20 minutes. Ventilating holes will be cut in the roof at every station, the total area of these being 7,300 sq. ft. Thus far 680 sq. ft. of such openings have been provided. At a point midway between stations louvre valves will be installed, through which air will be forced out by the motion of trains. The total cost of the work now being done is $300,000.—*The Iron Age.*

TRAVELING ENGINEERS' ASSOCIATION.—The officers elected for the ensuing year are: President, W. J. Hurley, New York Central, Buffalo; first vice-president, A. M. Bickel, L. S. & M. S. Ry., Elkhart, Ind.; second vice-president, J. A. Talty, D., L. & W., Buffalo; third vice-president, Chas. F. Richardson, 'Frisco Line, St. Louis; secretary, W. O. Thompson, New York Central, Oswego, N. Y.; treasurer, C. B. Conger, International Correspondence Schools, Chicago. The 1907 convention will be held in Chicago.

SOUTH LOUISVILLE SHOPS.

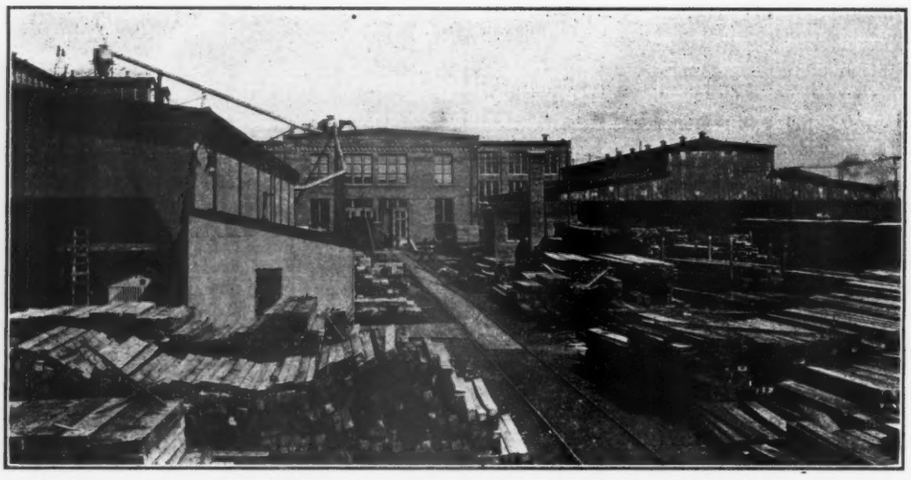
LOUISVILLE & NASHVILLE RAILROAD.

II.

CAR DEPARTMENT.

The general plan and operation of these shops were considered on page 209 of our June, 1906, issue. They are located on a marshy piece of ground, and it was therefore necessary to support the concrete foundation walls and piers on creosoted piling driven through the sand and quicksand to gravel.

The buildings are all of very substantial construction. The style of architecture is plain, no attempt being made at decoration. The shop for the building of new freight cars, the freight car repair shop and the lumber shed are of steel construction, the side sheathing being of corrugated iron. The planing mill, the wheel and car material building, and the coach, paint and tender shop have red brick walls with steel frame work. Special attention was given to securing good daylighting in all of the buildings. The roofs are covered with a composition roofing material. Terra cotta and stone are used for coping, sills, etc. Circular ventilators are placed along the ridges of the roofs. All gutters and spouts are of copper. The interior steel work is painted gray.



LOOKING NORTH FROM SILL YARD—LUMBER SHED TO THE LEFT, PLANING MILL IN CENTER, FREIGHT CAR SHOP TO THE RIGHT.

As stated in the first article, the buildings are very carefully arranged, so that the raw material enters at each end of the plant: wood at the south end and metal at the north end; and, as far as possible, travels with a minimum amount of handling and without doubling on its tracks until it reaches its objective point in the finished state. With this in mind, the buildings and equipment of the car department will, as far as possible, be described in the order in which the material is handled after it enters the plant.

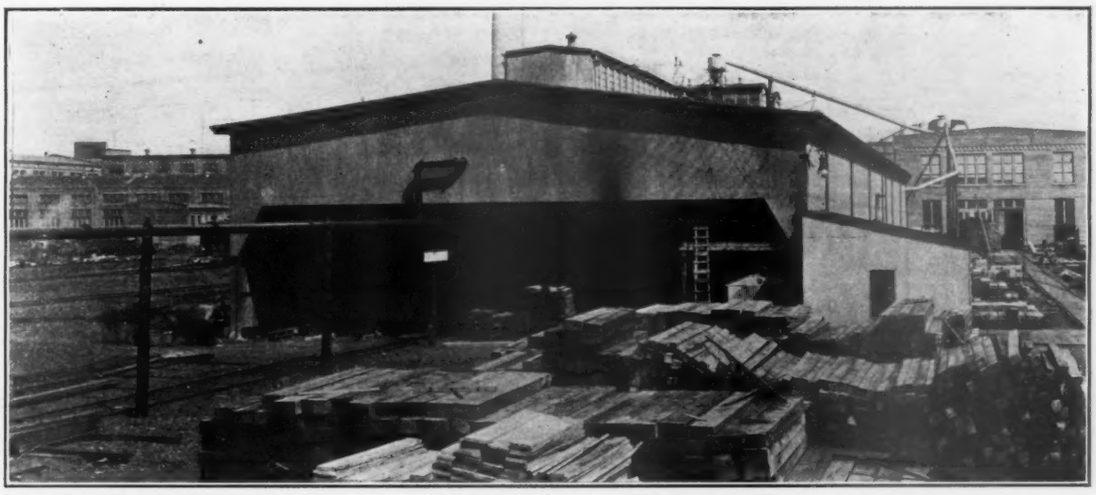
The sills are stored in a space east of the dry kiln (see general plan, page 208); tracks lead directly from this space to the planing mill and transfer table. Other lumber is stored to the west of the dry kiln and lumber shed. The tracks in this yard are spaced 60 ft., center to center, and the lumber is handled on cars 2 ft. high, all platforms being built the same height, to facilitate loading and unloading.

DRY KILN.

The dry kiln is a brick building, 65 x 104 ft., divided into three rooms, each 20 ft. wide, by longitudinal brick walls. It is equipped with the National patent moist air lumber dryer system, designed by the National Dry Kiln Company, Indianapolis, Ind. At each end are covered platforms, 24 ft. wide, one for receiving and the other for discharging the lumber. Alongside of these platforms are transfer tracks for the trucks which handle the lumber to and from the kiln. One of the illustrations shows the platform at the receiving end. The kiln has a holding capacity of 180,000 ft. of lumber. At the exhaust end of each section is a large flue which has eight openings into the drying room. These openings have independent dampers, and it is thus possible to closely regulate the temperature of the room. The steam headers in each room are also independent and equipped with regulating valves. The three rooms may therefore be operated at different temperatures, and it is thus possible to dry three different kinds of stock at the same time.

Each room contains two tracks of 6-ft. gauge. The rails, as well as the channels which carry the steam pipes, are supported on concrete piers. There is a double layer of heater pipes a little below the level of the rail which covers almost the entire floor area. Exhaust steam from the power house is used, although provision is made for using live steam, if necessary. The tracks and the heater pipes have an inclination of 3-16 of an inch to a foot. The walls of the building are of brick, with concrete foundations, and the roof trusses are of wood, ceiled on the underside (13 ft. 2 ins. from the top of rail) with two thick-

INTERIOR OF PLANING MILL



LUMBER SHED.

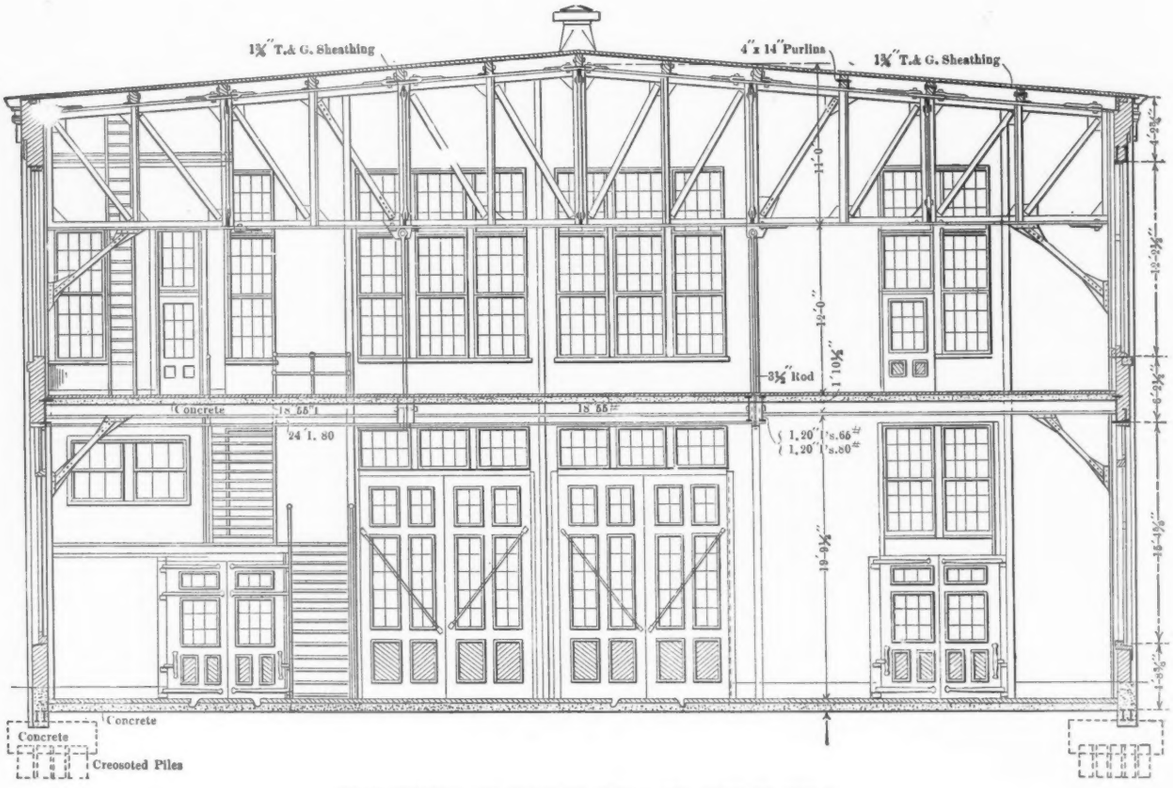
nesses of T and G boarding ⅞ in. thick, with building paper between. The roof consists of ⅞ in. sheathing, covered with composition roofing.

LUMBER SHED.

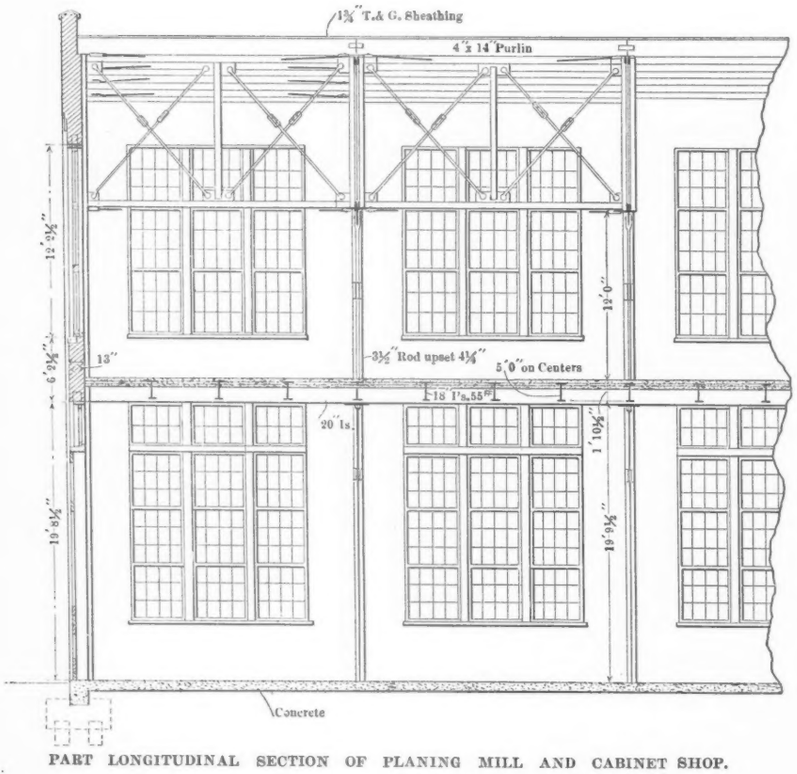
The lumber, after passing through the dry kiln, is stored in a lumber shed which lies 100 ft. to the north. This is a steel shed, 70 ft. wide by 260 ft. 7½ ins. long and about 25 ft. high at the eaves, and 35 ft. high over the clerestory. The sides are covered with galvanized corrugated iron to within 10 ft. of the ground, and the ends to within 16 ft. of the ground. During cold weather the open sides are boarded up. A composition roofing is laid on 1¾-in. sheathing nailed to 4x16-in. purlins, which are secured to the steel roof trusses by 2x⅜ in. iron straps. A clere-story, 10 ft. wide and about 6 ft. high, extends almost the entire length of the shed, and this, in connection with the open sides and ends, furnishes good daylighting. Two tracks extend through the shed and lead to the planing mill and transfer table. The lumber is stored on the cinder floor between the tracks and on a platform, or gallery, extending along one side of the shed. At the end of the shed nearest to the planing mill is a small group of machinery consisting of a cut-off saw, a light rip saw and a re-saw, and driven by a 60-h.p. Western Electric motor. This machinery is used very largely for manufacturing grain doors. The resaw is used for sizing lumber before it goes to the planing mill. The machines are connected to the shaving exhaust system in the planing mill.

RECEIVING PLATFORM OF DRY KILN.

PLANING MILL, SHOWING SHAVING EXHAUST PIPE EXTENDING TO THE ROOF OF THE POWER HOUSE.



CROSS-SECTION OF PLANING MILL AND CABINET SHOP.

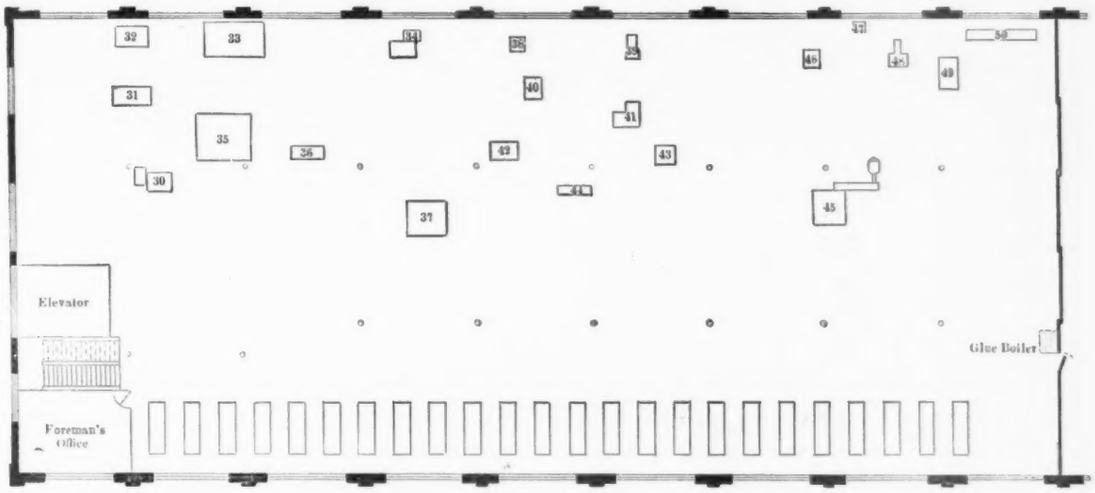


PART LONGITUDINAL SECTION OF PLANING MILL AND CABINET SHOP.

PLANING MILL.

The planing mill is a two-story steel frame brick building, 80 x 562 ft., with the cabinet shop on the second floor. It faces the transfer table and lies between the coach shop and the new freight car shop. If necessary, the building may be extended 100 ft. to the south, as shown on the general plan, page 208. An interesting feature in the design of the building is that no columns are used for supporting the second floor, but it is carried entirely by wall connections and by suspension rods from the roof trusses. A line of 20-in. I beams is built into the inner face of each side wall, a little below the level of the second floor, as shown in the sectional view of the building. Two pairs of 20-in. I beams are supported by 3½-in. rods, which are upset to 4¼ ins. at the lower ends to take nuts, and are connected to the roof trusses at the upper ends by pins. These beams divide the width of the building into three parts, and between the beams are framed 18-in. I beams placed transversely, 5 ft. center to center. Upon this steel framing is laid a concrete floor, with a granitoid wearing surface, designed for a load of 250 lbs. per sq. ft. The main floor is also of concrete, with a granitoid wearing surface. The roof is carried by 4 x 14-in. purlins supported on the steel roof trusses, and consists of 1¾-in. sheathing covered with a composition roofing.

A study of the arrangement of the machinery will show that the rough material is intended to enter the planing mill at the south end and comes out at the north end to the transfer table in a finished state. Material is conveyed to the cabinet shop by a 5-ton elevator at the north end of the building, operated by a 25-h.p. motor. A track extends from the transfer table to the elevator platform. There is also a stairway at each end of the building. The large machines are all connected to a shaving exhaust system. Three exhaust blowers discharge the shavings into bins on top of the building and they are transferred from these to the power house by another blower. The arrangement of the exhaust pipes in connection with one of the short sill dressers is clearly shown on the interior view of the planing mill, and the arrangement of the storage



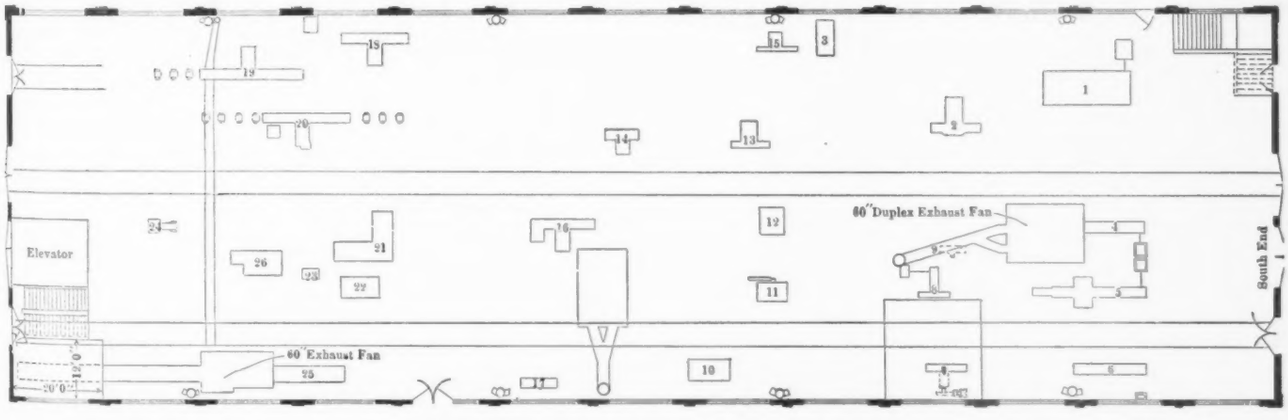
ARRANGEMENT OF TOOLS IN THE CABINET SHOP.

pockets on top of the building and the piping from them to the power house is shown on several of the illustrations. The larger tools are driven by individual motors, while the smaller ones are arranged in groups. Following are lists of the machine tools and motors in the planing mill and cabinet shop, with numbers corresponding to those on the diagrams, showing the arrangement of the machinery in these two shops.

PLANING SHOP TOOLS.

No.	NAME.	MOTOR.	
30	Carriage cut-off saw, No. 2, Fay & Egan	W. E.,	30 h.p.
31	Rip saw, Bental & Margedant Co.		
32	Rip saw, Bentel & Margedant Co.		
33	Planer and matcher, No.. 8, Fay & Egan		
34	Tenoning machine, No. 2, Fay & Egan		
35	Combination universal woodworker and moulder No. 3, Fay & Egan		
36	4-side 4-in. moulder, No. 1½, Fay & Egan		
37	Pony planer, 24-in. blade, Goodell & Waters Co.		
7	Cut-off saw, 34-in., Egan Co.	Bullock,	8 h.p.
8	Cut-off saw, 34-in., Egan Co.	Bullock,	14 h.p.
9	Cut-off saw, 32-in., J. A. Fay & Co.	W. E.,	30 h.p.
10	Surfacer, 26-in. blade, Fay & Egan		
11	Heavy rip saw, 28-in. No. 153, S. A. Woods Co.		
12	Light rip saw, 28-in., Greenlee Bros. & Co.		
13	5-spindle borer, Greenlee Bros. & Co.	W. E.,	30 h.p.
14	Vertical hollow chisel mortiser, No. 154, Fay & Egan		
15	Sill tenoner, 3 cutters, Fay & Egan	W. E.,	30 h.p.
16	Gainer, Greenlee Bros. & Co.	Bullock,	14 h.p.
17	Swing cut-off saw, 24-in., L. & N. R. R.	Bullock,	5 h.p.
18	5-spindle borer, Fay & Egan		
19	Vertical hollow chisel mortiser with traveling table, No. 154, Fay & Egan	Bullock,	18 h.p.
20	Automatic car gainer, No. 150, Fay & Egan	Bullock,	18 h.p.
21	Universal car tenoner, Fay & Egan		
22	Horizontal borer, Fay & Egan		
23	Vertical single spindle borer, Bental & Margedant.	W. E.,	50 h.p.
24	Band saw, No. 2, Fay & Egan		
25	Dimension planer, 24-in. blade, Fay & Egan		
26	Universal wood-worker, Fay & Egan	Bullock,	8 h.p.

The cabinet shop is, as far as possible, so arranged that the work coming from the elevator passes along one side of the



ARRANGEMENT OF TOOLS IN THE PLANING MILL.

38	Mortiser, No. 71, Fay & Egan	Bullock,	14 h.p.
39	Vertical double spindle boring machine, No. 2, Fay & Egan		
40	Double spindle shaper, No. 2½, Fay & Egan		
41	Mortiser and relisher, No. 93, Fay & Egan		
42	Combination saw and dado, No. 5, Fay & Egan		
43	Single head shaper, Fay & Egan		
44	Grindstone, L. & N. R. R.		
45	Sand papering machine, No. 4, Fay & Egan	Bullock,	18 h.p.
46	Combination panel carver and friezer, No. 4, Fay & Egan	Bullock,	8 h.p.
47	Plug cutter, Egan Co.		
48	Scroll saw, Fay & Egan Co.		
49	Marquit veneer saw, L. & N. R. R.		
50	22-in. x 12-ft. lathe, Putnam Mach. Co.		

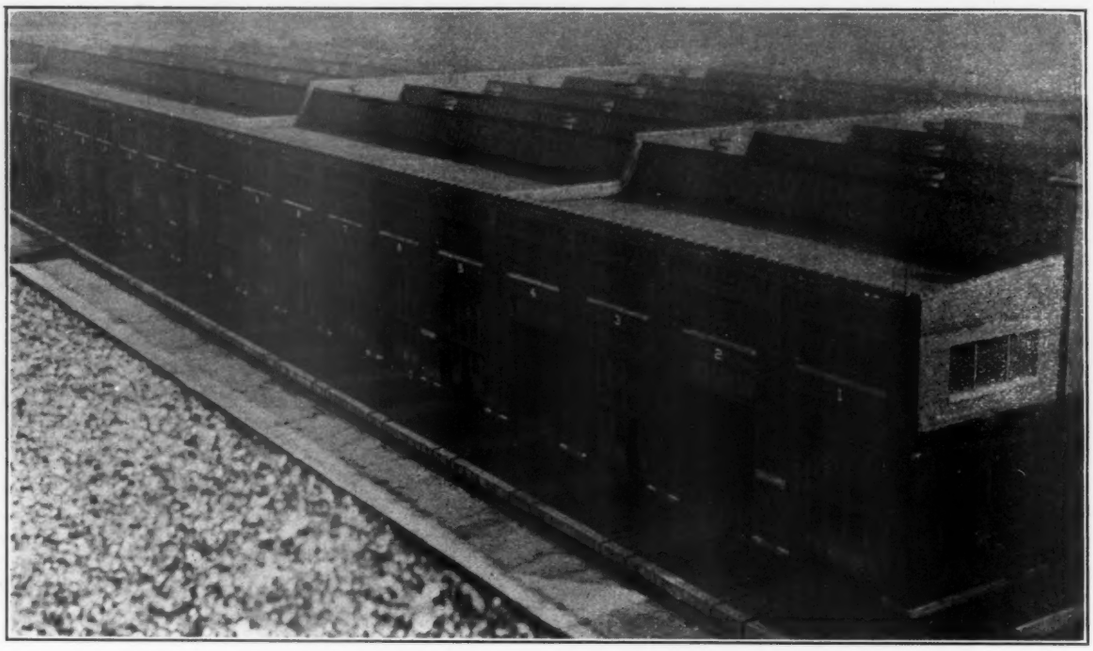
PLANING MILL TOOLS.

No.	NAME.	MOTOR.	
1	Short sill dresser, 20-in. blade, S. A. Woods Mach. Co.	Willey,	100 h.p.
2	Cut-off saw, 40-in., Greenlee Bros. & Co.	Bullock,	15 h.p.
3	Cut-off saw, 40-in., Greenlee Bros. & Co.		
4	Matcher, 15-in. blade, Fay & Egan	W. E.,	30 h.p.
5	Matcher, 10¼-in. blade, Fay & Egan	W. E.,	50 h.p.
6	Matcher, 10¼-in. blade, Fay & Egan	W. E.,	30 h.p.

shop and returns along the other side. The bench work is done along the western side. The open space between the benches and the machines is used for the erection of locomotive cabs and the storage of material. One end of the shop is fitted up as a tool room for sharpening and repairng saws and tools, and has a very complete equipment for carrying on this work. The building is heated by a hot-air system, the blowers being driven by electric motors, and exhaust steam from the power house being used to heat the air.

COACH, PAINT AND TENDER SHOP.

Just west of the planing mill, and directly across the transfer pit from the locomotive shop, is a building, 180 x 482 ft., which is divided by three brick fire walls, which extend above the roof, into four divisions. The openings in the fire walls are fitted with automatic sliding fire doors. The division on the east end, or nearest the planing mill, is divided into a



VIEW OF COACH SHOP, FROM THE ROOF OF THE LOCOMOTIVE SHOP.

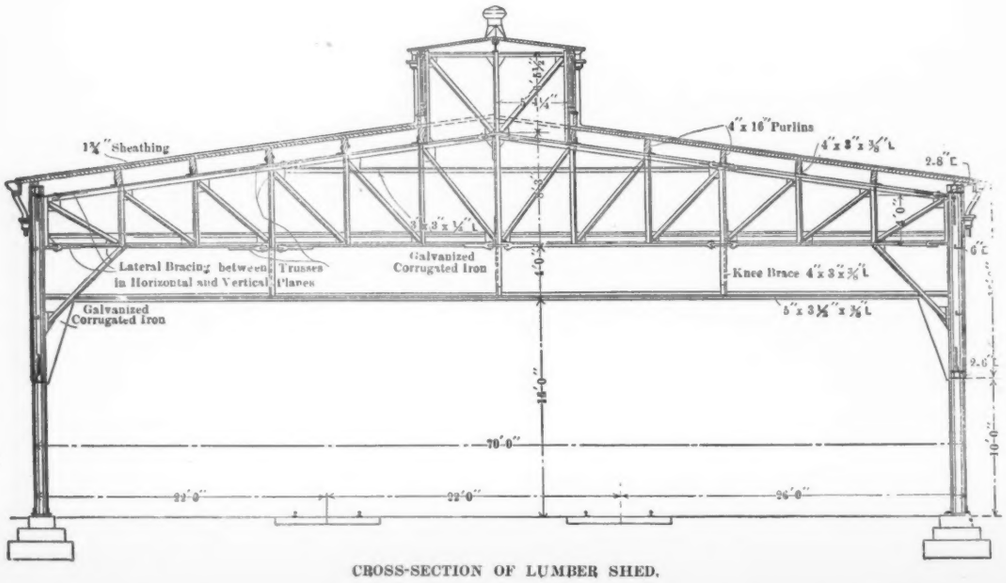
room, 59½ ft. x 87 ft. 11½ ins., which is devoted to work on passenger trucks, and into a store and brass finishing room, and above the latter two is an upholstering room and a wash-room. The next division is 218 ft. 11 ins. x 178 ft. It is devoted entirely to coach work and has eleven tracks, spaced 20 ft., center to center, each one of which will hold two coaches. The third division, 118 ft. 11 ins. wide, is used as a coach paint shop and has six tracks running through it, each one of which will hold two coaches. The tender shop at the west end is 79 ft. 5 ins. wide and is equipped with a shallow pit transfer table, driven by an electric motor, as shown on the drawing. It has a capacity for fifteen tenders. The tracks just south of the shop are used for storing tenders.

The construction of the building is clearly shown by the sectional views. The daylighting is splendid, due to the very large amount of window space in the side and end walls and to the saw-tooth roof construction. The saw-tooth frames are carried by the parallel cord trusses, spaced 20 ft., center to center, which are supported by the wall columns and a central row of columns. A composition roof is laid on 1¾-in. sheathing. The floor is of concrete with a granitoid finish. The large doors are arranged to slide upward instead of swinging inward.

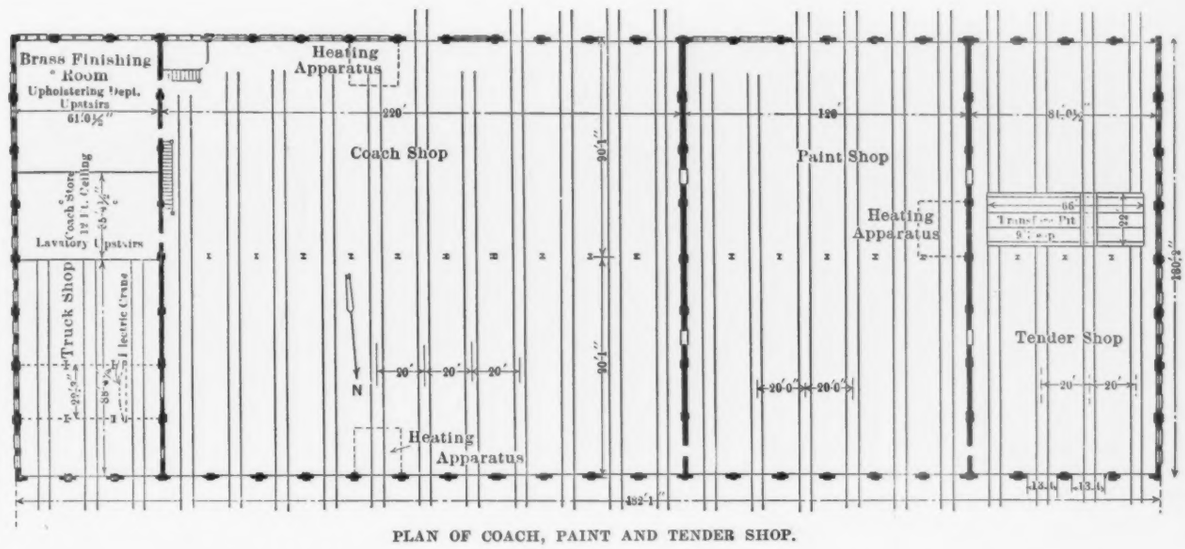
If the transfer table should, for any reason, be temporarily put out of service, several of the tracks in the coach, paint and tender shop extend through the shop at the south end and connect with the yard tracks, and coaches and tenders could, if necessary, be removed over these tracks. A short distance south of the paint shop is a small brick building, 32 ft. 10 ins. x 52 ft. 10 ins., which is used for the storage of paints and oils. The foundations are of concrete and the floor is of reinforced concrete, with a granitoid wearing surface. The roof is of Book tile, covered with composition roofing material, and is supported by steel trusses. The passenger truck shop is equipped with a 10-ton electric crane. The wash-room is equipped with expanded metal lockers. The entire building is heated by hot air, the fans and heating apparatus being supported on platforms placed above the roof trusses and arranged as shown in the plan.

NEW FREIGHT CAR SHOP.

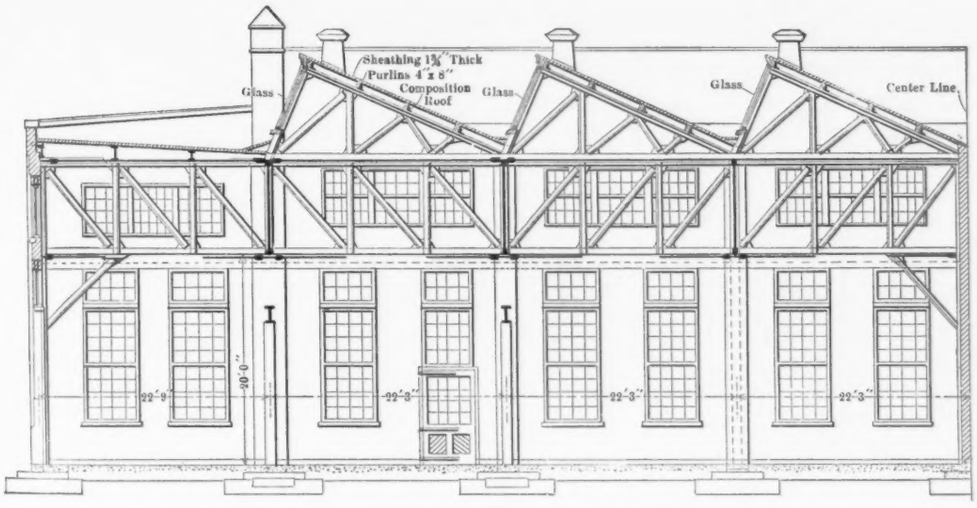
The shop for building new freight cars lies east of the planing mill and is 300 ft. 7⅜ ins. long and 134 ft. 8 ins. wide. Provision is made for an extension 200 ft. to the south, if necessary. The building is entirely of steel construction, as shown by the accompanying views. The columns supporting the roof trusses divide it into three parts, each part containing two tracks for the building of cars, with a material track of standard gauge between them. The six building tracks have a capacity for 42 cars. The ends of the building are covered with corrugated galvanized iron to within 16 ft. 9 ins. of the ground, and the sides are of the same material to within 10 ft.



CROSS-SECTION OF LUMBER SHED.



PLAN OF COACH, PAINT AND TENDER SHOP.



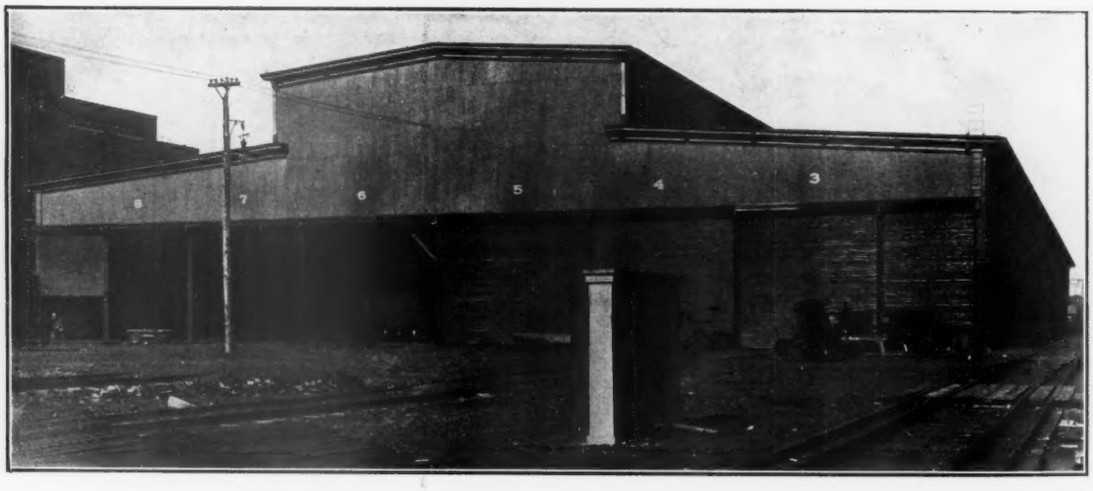
HALF CROSS-SECTION OF COACH, PAINT AND TENDER SHOP.

The timber is transferred from the planing mill, either over the transfer table or the lighter timber is handled directly from the mill on push-cars. The trucks and such other stores as are kept in the car material building, which lies between the blacksmith shop and the foundry, are placed by the traveling crane on the transfer table and are then pushed directly into the shop. Considerable material, such as bolts, is stored underneath the platforms at the sides of the building, and surplus material, such as large castings and finished lumber, is stored between the tracks, just south of the shop. Ordinarily, three of the tracks in the shop are used for erection purposes while material is being brought in and placed alongside of the other three. If necessary, however, all six tracks may be used for erecting purposes at the same time, and the material can be placed during the

of the ground. Both the sides and ends of the building are equipped with rolling steel doors. Extending over the middle of the center bay for its entire length is a monitor, or clere-story, fitted with skylights. There are also a series of monitors fitted with skylights extending over the middle of each side bay. A large area of stationary sash also extends along each side of the building above the corrugated iron sheathing. The scaffolding, or suspended platforms, alongside the building tracks are of permanent construction. The platforms are about 4 ft. wide and are supported about 7 ft. above the floor by angles hung from the roof trusses. Extensions on either side of the platforms, 2 ft. 6 ins. wide, are hinged to them so that they may be folded over out of the way when not in use. The photograph shows them folded back, while the drawing shows them extended for use. They are held in a horizontal position by ¼-in. wire rope cables which are fastened to the roof trusses. A composition roofing is used and the floor is of concrete, with a granitoid finish.

PART LONGITUDINAL SECTION OF COACH SHOP AT EASTERN END.

INTERIOR OF COACH SHOP.



FREIGHT CAR REPAIR SHOP.

night time. In this way it is possible to turn out forty-two gondola cars per day.

FREIGHT CAR REPAIR SHOP.

The freight car repair shop is also entirely of steel construction, and lies beyond the transfer table and to the north of it. The space east of the freight car shop is used as a storage or cripple yard and will accommodate about 325 cars. The building is 145 ft. wide x 400 ft. 7⅞ ins. long and has a capacity for about sixty cars. If necessary, it may be extended 200 ft. to the north, increasing the capacity thirty cars. There will still be sufficient room to the north of the extension so that, during favorable weather, about fifty cars may be repaired in the open. The building contains six repair tracks, spaced 20 ft., center to center, and a material track along the western side. A row of work benches is placed along the eastern side. The daylighting is splendid. Stoves are provided so that during cold weather the men will have a place to warm themselves.

NEW FREIGHT CAR SHED.

INTERIOR OF FREIGHT CAR REPAIR SHOP.

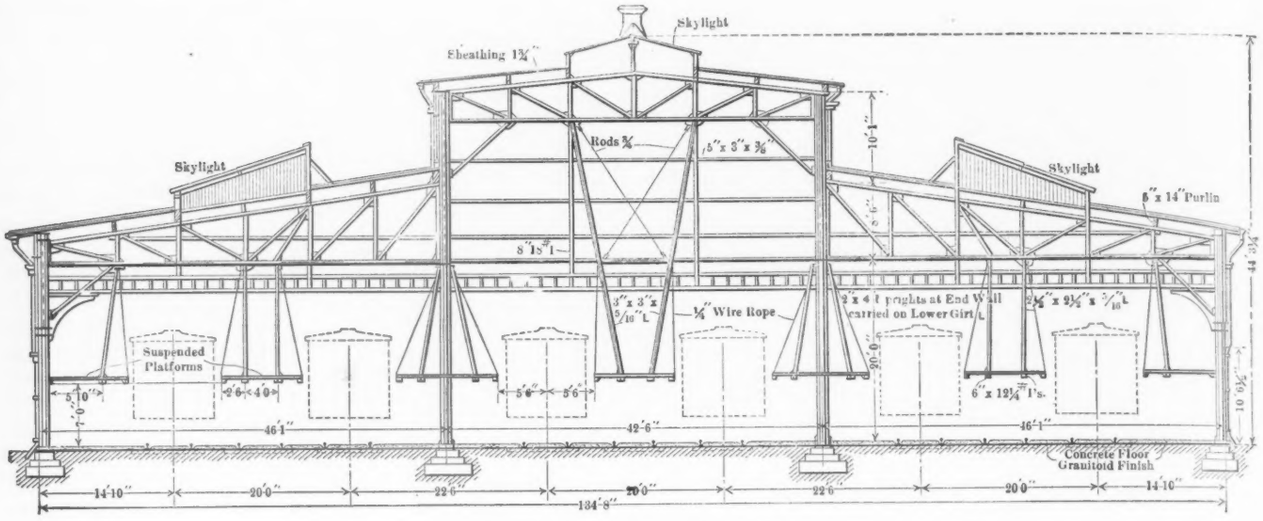
The building is lower than the one used for the building of the new cars and, while the cross-section is quite similar as regards shape, the arrangement of the trusses is very different. Only one intermediate row of columns is required for supporting the roof trusses. It has a clere-story and monitors over the center and side bays similar to those on the freight car shop, and has a row of stationary sash on the sides above the corrugated iron sheathing. Along the western side of the building is a platform, or balcony, for the workmen's tool boxes. The foreman's office is elevated and is at the northwest corner of the building, furnishing a view both through the shop and over the freight car repair tracks. The sides and ends of the building are equipped with rolling shutters. The floor is of cement, with a granitoid finish. Between each pair of tracks are compressed air connections, the hose extending down from the roof trusses. As the cars are completed, they are taken out at the north end of the building, are switched out over the belt line at the eastern side of the shop and are then weighed on the scales, which are placed near the southeast corner of the building, and are shown in one of the photographs. They leave the plant at the end at which they are received.

INTERIOR OF NEW FREIGHT CAR SHOP.

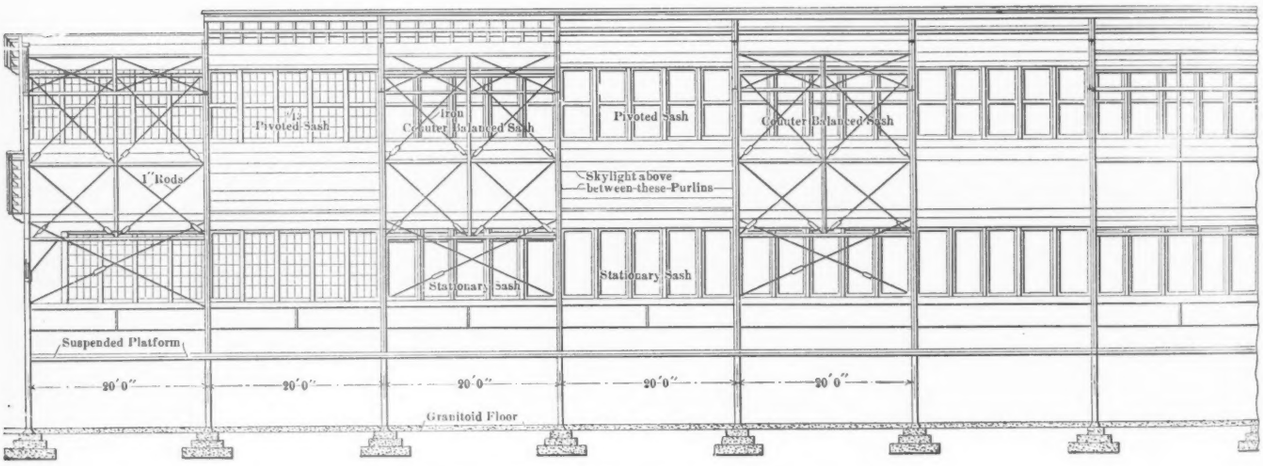
CAR MATERIAL AND WHEEL SHOP.

This building is situated between the blacksmith shop and the foundry alongside of the traveling crane and about opposite the end of the freight car repair shop. It is a steel frame brick building, 90 ft. 7 ins. x 202 ft. 1 in., and is divided into three parts by wooden partitions which extend as high as the underside of the roof trusses. The roof has a wide, high, monitor extending almost its entire length, the sides and ends of which are almost entirely of glass, thus furnishing splendid daylighting. A little over one-third of the building at the north end is used as a wheel shop and for the storage of truck springs and the erection of car-wheel trucks. The two truck-erecting tracks extend out underneath the transfer crane. The wheel shop contains three heavy double Niles axle lathes, No. 3; a Bement & Son single axle lathe; a Pond single axle lathe; a Niles car-wheel lathe; three 42-in. Niles car-wheel boring machines; a Safety Emery Wheel Company emery wheel, and two Niles wheel presses, No. 2, one of which is used for pressing on the wheels and the other for pressing them off. The boring mills are driven by a Bullock 18-h.p. motor, while the rest of the machinery is driven by a 60-h.p. motor of the same make. This machinery is grouped along the north end of the building.

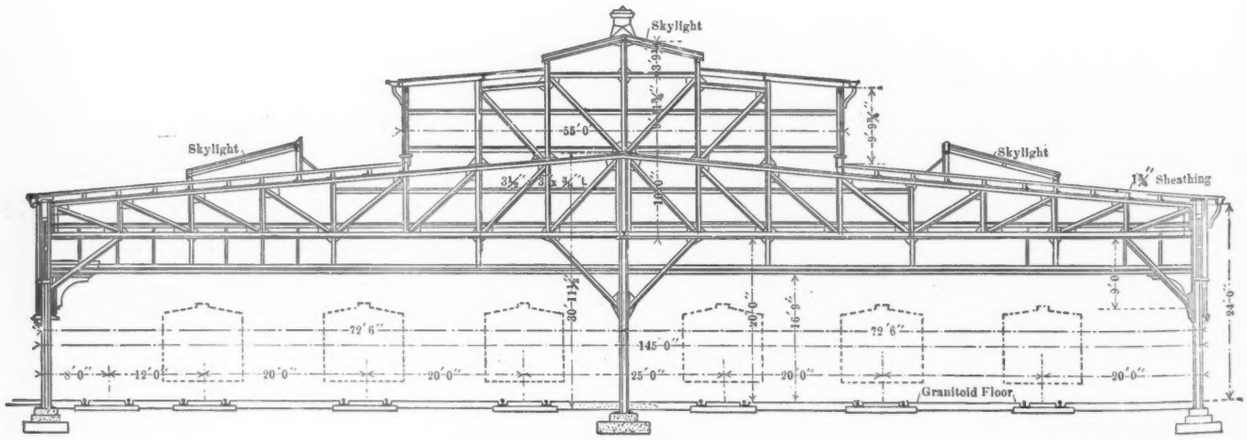
The middle section of the building is used as a freight car storeroom and contains light material, such as small castings,



CROSS-SECTION OF NEW FREIGHT CAR SHOP.



PART LONGITUDINAL SECTION OF NEW FREIGHT CAR SHOP.

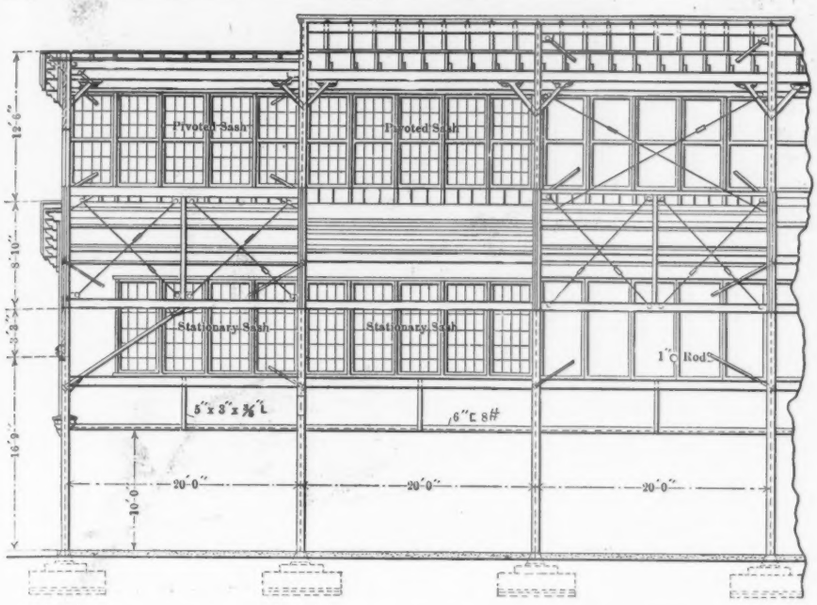


CROSS-SECTION OF FREIGHT CAR REPAIR SHOP.

brake rigging, car roofs, air hose, nails, screws, etc.

The end section of the building is only about half as large as the other two and is used as a pipe shop. It is equipped with two 2-in. Merrill Mfg. Company pipe threaders and a 2½ to 12-in. pipe threading and cutting machine, made by the Curtis & Curtis Company. These are driven by a 8-h.p. Bullock motor. The room is also equipped with large racks for the storage of pipes and with benches and vises for pipe work. It also has apparatus for fitting up air brake hose.

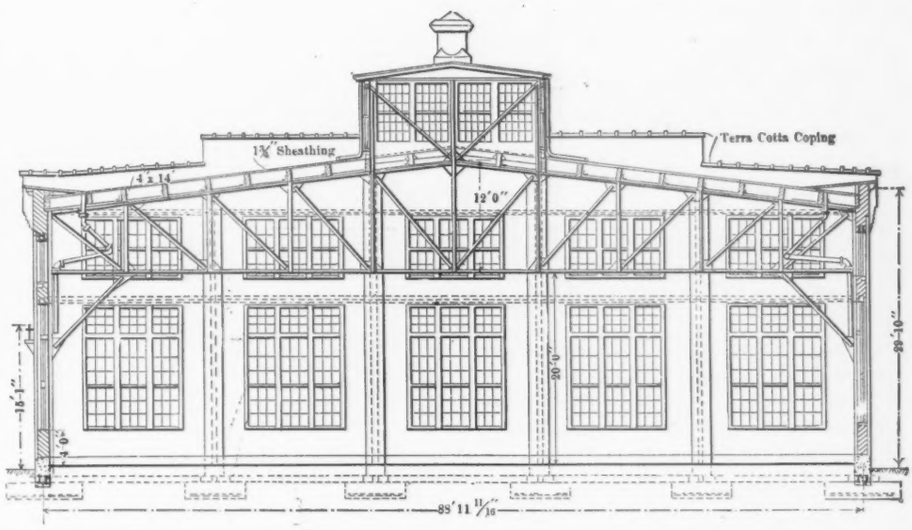
The space west of the shop is used for the storage of car wheels and axles. The space underneath the traveling crane in front of the building is used entirely for the storage of car material, especially for that used in the construction of the trucks.



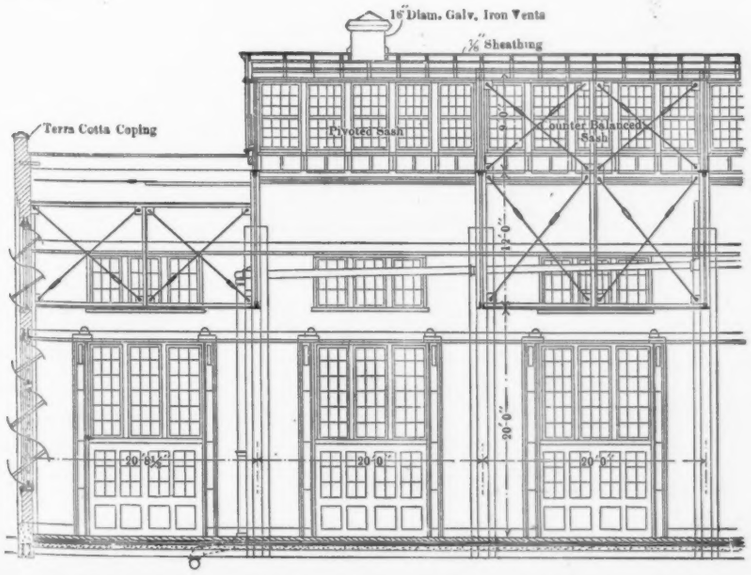
PART LONGITUDINAL SECTION OF FREIGHT CAR REPAIR SHOP.

STREET AND ELECTRIC RAILWAYS.—A supplement to the *Street Railway Journal* giving statistics for the street and elevated railway mileage, cars and capitalization shows that in 1905 there were in the United States 1,081 roads, with a track mileage of 33,150, and having 79,751 cars. The capital stock amounted to $1,844,565,136, and the funded debt to $1,524,371,926. Canada, including Newfoundland, had 42 roads, with a track mileage of 956 and 2,697 cars. The capital stock of these roads amounted to $42,935,636, and the funded debt to $30,906,597. In the insular possessions of the U. S., including Hawaii, Porto Rico and the Philippines, there are six roads having 87 miles of track.

A. L. A. M. STANDARD SCREW.—The Association of Licensed Automobile Manufacturers has adopted standard dimensions and specifications for hexagon-head screws, castle and plain nuts. The manufacturers of fine machinery have found the pitch of threads of the U. S. standard too coarse and the dimensions of the heads and nuts too large. Different manufacturers have tried to solve the difficulty by adopting dimensions of their own, and this has caused much confusion. The A. L. A. M. have, after careful study and investigation, adopted a set of standards for screws for this finer class of work and hope that it may eventually be generally adopted as standard for such work. The material for use in automobile work will be about twice as strong as ordinary screw stock. For screws of soft material U. S. standard standard pitches will be used.



CROSS-SECTION OF WHEEL SHOP AND FREIGHT CAR MATERIAL BUILDING.



PART LONGITUDINAL SECTION OF WHEEL SHOP AND FREIGHT CAR MATERIAL BUILDING.

CLEANING AND OILING BELTS.—Belts which have become too greasy and dirty should be cleaned with gasolene, then scraped and wiped with waste. In dry, dusty places it is well to brush them occasionally with a broom or stiff brush. No rosin or belt dope should be used except fish oil and tallow mixed in equal parts. Apply hot with a brush when the belt is running, or dip the belt in the dope tank, then dry and wipe off any grease which may have hardened on the belt. If applied while running, care should be taken not to get too much on the belt, or it will cause it to slip. No mineral oil should be allowed to come in contact with belts. New belts should be treated with fish oil and tallow before using, and any belt which becomes dry, hard and glossy in service should have an application of the dressing. This is especially true of belts in blacksmith shops. The oil will check to some extent the evil effects of the smoke, sulphur gases and dirt, and the life of the belt will thereby be lengthened.—*Mr. C. J. Morrison, American Machinist.*

Don't look for trouble unless you can handle it when you find it.

STANDARDIZING LOCOMOTIVE EQUIPMENT.

CANADIAN PACIFIC RAILWAY.

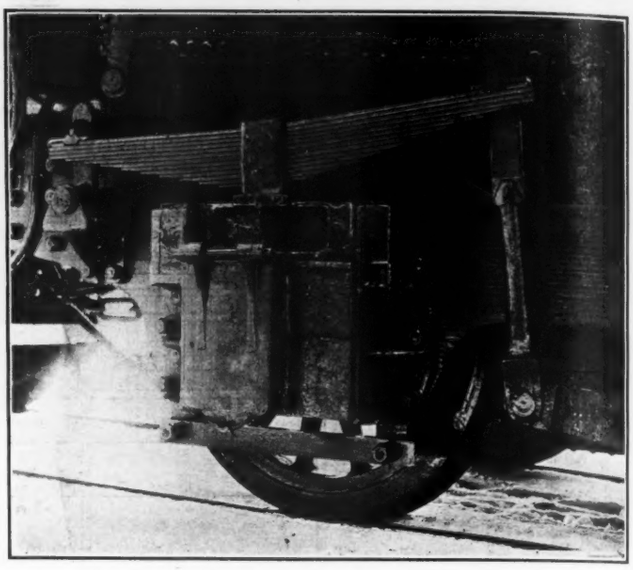
IV.

Radial Trailer Truck.—In connection with the class G1 and G2 Pacific type locomotives, general drawings and description of which were given on page 163 of the May issue, a design of radial trailer truck has been adopted as standard which differs in many respects from any of the designs now in general use on other railroads.

The rear frames of these engines are outside the trailer wheels and connect to the main frames through a heavy cast steel cross connection below the front mud ring. They are of plate, 2 ins. thick and about 12 ins. deep at the connection. A very broad deck casting spaces and stiffens them at the rear.

The pedestal is formed by two steel castings bolted on the outside of the frame. The faces of these castings are about 8 ins. broad and set at an angle with the center line of the locomotive, the front one being about 69 deg. and the rear 71½ degs. This gives the trailer wheel a movement at a radius of 10 ft. 7½ ins., making the center just back of the rear driving axle.

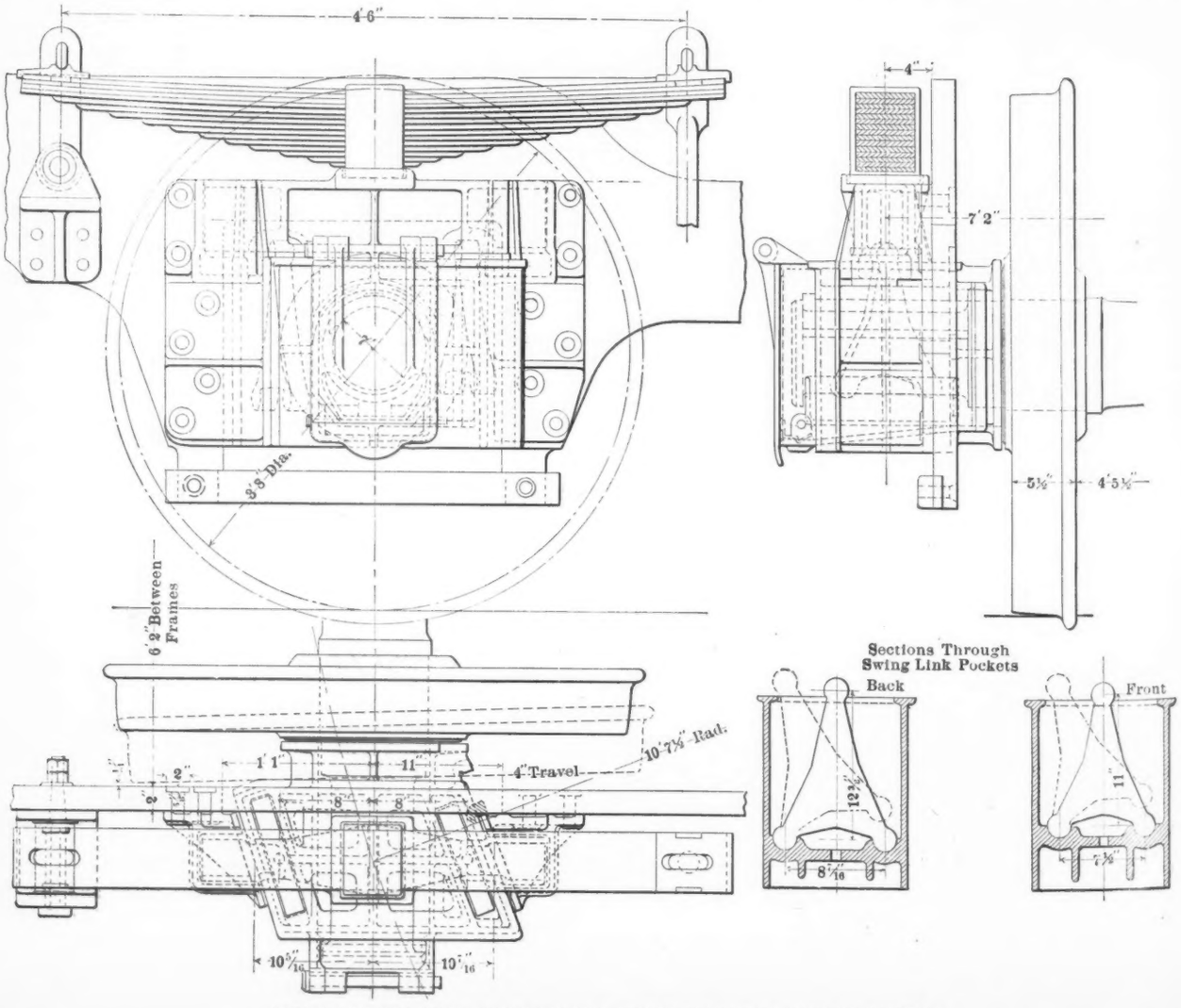
The journal box, a detail drawing of which is shown herewith, fits between the pedestals, having its bearing faces at the proper angles. There is but one lug for stopping the side motion, that being on the inner side of the front face. Parallel to the pedestal-bearing faces on either side are cored deep recesses in the box, of the shape shown by the cross section. In these recesses, triangular shaped struts rest in depressions formed at the bottom into bearings for the two lower legs, while the upper leg projects slightly above the top of the box.



STANDARD TRAILER TRUCK—CAN. PAC. RY.

Resting on top of these swing links is the spring seat of cast steel, a detail drawing of which is also shown. This spring seat is prevented from moving sidewise by having its ends fitted into pockets in the top of the pedestal casting, its vertical movement, however, being free. The semi-eliptical spring outside of the frame rests on the center of this casting.

The action of this truck is such that it offers considerable

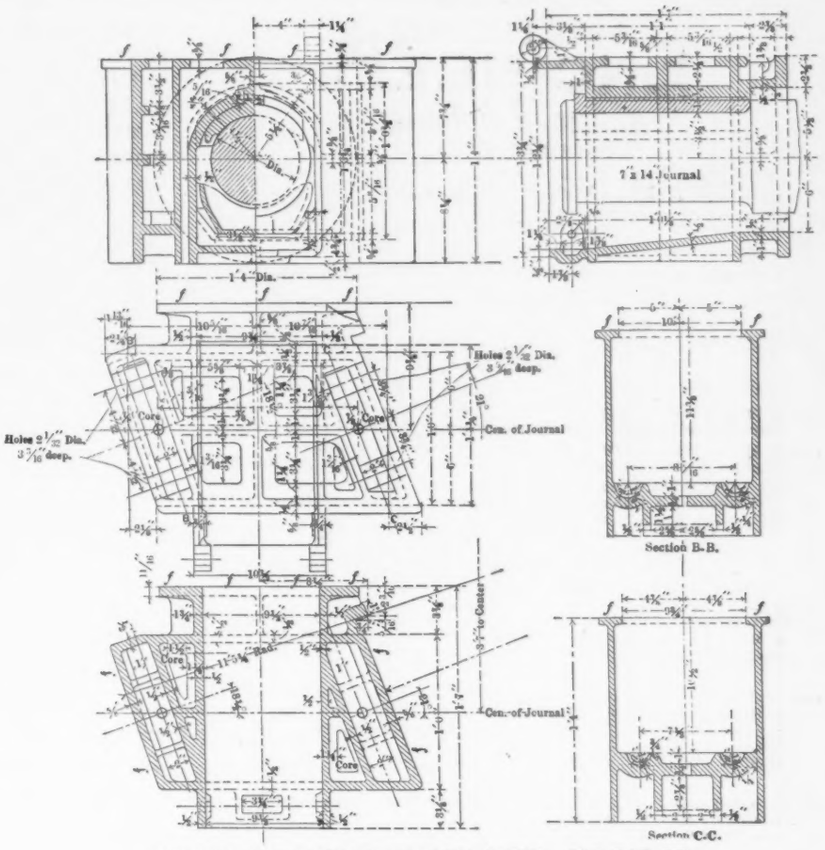


DETAILS OF STANDARD RADIAL TRAILER TRUCK—CANADIAN PACIFIC RAILWAY.

initial resistance to the lateral movement of the rear end of the engine, the amount of this resistance decreasing as the lateral displacement increases, until it becomes exceedingly small at the extreme movement allowed of 4 ins., the result is that, on straight track at any speed so far reached by the engines, this truck acts as though it were rigid, and there is a complete absence of the swinging horizontal movement occasionally found in long and heavy engines.

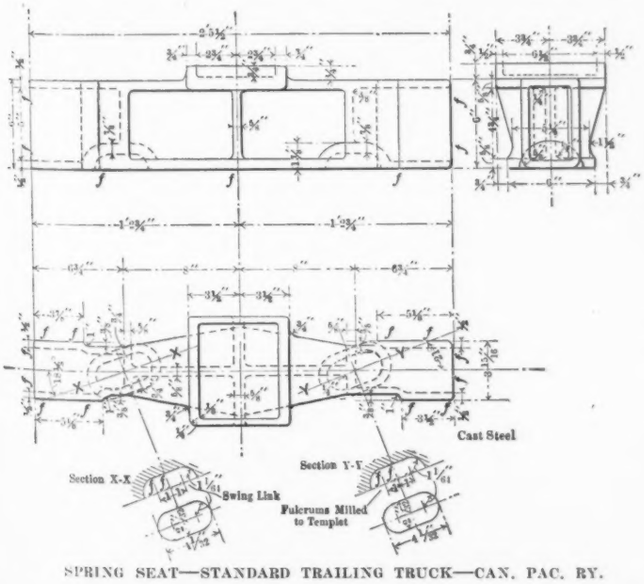
On switches and severe curves, when once the truck has been moved sideways, it gives way easily and allows the front truck to guide the engine around the curve without its action being opposed by the lateral resistance of the trailing truck that is the case in all other designs. The results obtained from this truck in service are very satisfactory. The road on which the engines are working is heavily graded, with frequent curves as high as six degrees in curvature, which are taken freely and steadily at high speeds, and after from six to nine months' service there is no evidence of any flange wear on any of the wheels, and no defect has yet been noticed in the track, in spite of the fact that these engines are considerably heavier than the other power in service.

An application for a patent for this design of truck has been applied for in the United States.



JOURNAL BOX—STANDARD TRAILING TRUCK—CAN. PAC. RY.

HOLDING POWER OF RAILROAD SPIKES.—The Forest Service has completed a series of tests to determine the holding power of different forms of railroad spikes. The tests were made on ordinary commercial ties of loblolly pine, oak, chestnut, and other woods. The spikes used were of four kinds:



SPRING SEAT—STANDARD TRAILING TRUCK—CAN. PAC. RY.

common driven spikes, a driven spike which has about the same form as the common spike with a lengthwise channel on the side away from the rail; screw spikes of the American type; and screw spikes similar to those in use on European railroads, and differing from the American spike mainly in the manner of finishing the thread under the head. The common and the channeled spikes were driven into the ties in the usual manner to a depth of 5 ins. A hole of the same diameter as the spike at the base of the thread was bored for the screw spikes, which were then screwed down to the same depth as the driven spikes. The ties were then placed in the testing machine, and the force required to pull each spike was recorded.

The average force required to pull common spikes varies from 7,000 lbs. in white oak to 3,600 lbs. in loblolly pine, and 3,000 lbs. in chestnut. The holding power of the channeled spike is somewhat greater; for example, about 11 per cent. more force, or 4,000 lbs. is required to pull it from the loblolly pine tie. The two forms of screw spike have about the same holding power, ranging from 13,000 lbs. in white oak to 9,400 lbs. in chestnut, and 7,700 lbs. in loblolly pine. There is a marked difference between the behavior of driven and screwed spikes in knots and in clear wood. Knots are brittle and lack elasticity, so driven spikes do not hold as well in them as in clear wood. In the case of common spikes in loblolly pine the decrease of holding power in knots is as great as 25 per cent. On the other hand, screw spikes tend to pull out the whole knot which they penetrate. This increases the resistance so much that in loblolly pine the increase of holding power of screw spikes in knots is about 35 per cent. over that for clear wood.

ESTIMATING THE WEIGHT OF TUBES.—Below is a rule which I have found useful for finding the weight per running foot of pipes, tubes and columns, and is expressed in the following formula:

$$W = K\ (D^2 - d^2)$$

in which

D = outside diameter.
d = inside diameter.
W = weight per running foot.
K for wrought iron = 2.64
K for cast iron = 2.45
K for brass = 2.82
K for copper = 3.03
K for lead = 3.86

The constant for cast iron (2.45) is based on cast iron weighing 0.26 pounds per cubic inch, or 450 pounds per cubic foot. It is best to add 10 per cent. to these figures in order to provide for overweight in the foundry.—*Alex. C. Labar, in Machinery.*

(Established 1832).

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Contributions.—*Articles relating to railway rolling stock construction and management and kindred topics, by those who are practically acquainted with these subjects, are specially desired. Also early notices of official changes, and additions of new equipment for the road or the shop, by purchase of construction.*

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CONTENTS.

	PAGE
Mallet Articulated Compound Locomotive, Great Northern Ry	371*
Erie Hospital Car	376
The Surcharge Problem, by C. J. Morrison	376
The Articulated Locomotive	377
Cooling and Ventilating the New York Subway	377
Traveling Engineers' Association, Officers of	377
South Louisville Shops—Car Department—L. & N. R. R.	378*
Street and Electric Railways—Statistics	387
Standard Screw—A. L. A. M.	387
Belts, Cleaning and Oiling	387
Standardizing Locomotive Equipment—Can. Pac. Ry	388*
Holding Power of Railroad Spikes	389
Estimating the Weight of Tubes	389
Mallet Articulated Compound	390
Reading Technical Papers	390
Instruction of Apprentices	390
A Motive Power Department Problem	391
The Combustion Chamber on Locomotives	391
The Surcharge Problem	391
Locomotives With Combustion Chambers—Northern Pacific Ry	392*
Railroad Y. M. C. A.	395
The Cost of Railway Operation	395
Waterproof Glue	395
Steel Underframe Postal Car—Santa Fe System	397*
Discipline in the Blacksmith Shop, by A. W. McCaslin	398
Nomenclature of the Walschaert Valve Gear	400*
Boltless Cast Steel Freight Trucks	400*
250-Ton Portable Crank Pin Press	401*
Chicago's Freight Tunnel	401
600-Ton Hydraulic Wheel Press	402*
The Locomotive Engineer	402
Car Wheel Grinder	403*
Planer Type Milling Machine	404*
Result of the M. C. B. Letter Ballot	404
Interesting Attachment to a Pipe Machine	405*
Golden "Clean Seat" Valves	405*
New Springfield Engine Lathe	406*
Master Blacksmiths' Association, Officers of	406
Result of M. M. Letter Ballot	406
Personals	406
Books	408
Catalogs	408
Business Notes	410

Several communications have recently been received by the editorial department requesting us to present articles on certain subjects. We are always pleased to receive letters of this kind; in fact, the more of them we receive the better we like it. It is advisable, however, that the writer give his name and address, as in several instances the information requested had already appeared in our columns, or was such that we could not very well present it, although we could very readily have advised the writer just where he could obtain the information, and would have taken pleasure in doing so if we had known his proper name and address.

The purchase of five locomotives of the Mallet articulated compound type by the Great Northern Railway, one of which is illustrated in this number, probably marks the beginning of a fairly general use of this type of locomotive where conditions for which it is specially adapted are found. The only previous example in this country, which has been in pushing service on the Baltimore & Ohio Railroad for over two years, is reported to be entirely satisfactory as regards design and service, and the type in smaller sizes has been in successful operation in other countries for a number of years. As far as the type itself is concerned, it can safely be accepted as a success, from an operating standpoint, at least. But, considering individual examples of a size which have thus far been used in this country having over 70,000 lbs. tractive effort, their ultimate success in service approaching regular road work will no doubt largely depend upon the introduction of a successful mechanical stoker capable of covering 78 sq. ft. of grate area with coal at the rate of over 3 tons an hour.

In large manufacturing concerns it is very often customary for the publication department to examine the technical papers which are received and to mark certain articles and forward them to such of their engineers as may be specially interested in that particular subject. An application of this same system was recently found in the motive power department of a large railroad. The technical papers are carefully examined, and such articles as may be of interest to different foremen are forwarded to them. A list of the technical journals which each foreman takes is kept in the office, and when the article to which it is desired to call his attention is in one of these papers he is sent a note referring him to the article and to the page upon which it will be found. The management of the road realizes the importance of having its foremen carefully read the technical papers, and encourages them to do so. In fact, it is deemed of such importance that if a good man is found who does not read at least one technical paper he is given to understand that he must do so in order to be eligible for promotion.

A number of railroads have taken up the question of furnishing their apprentices with instruction in mathematics and mechanical drawing. In several instances where this has been done in the past it has fallen flat, or, at least, not produced the results it should, because the courses were not properly arranged. It is usual, in taking up mechanical drawing in our technical schools, to start in with work on geometrical exercises, and it is some time before the student is allowed to make a practical application of the principles learned in this way. This treatment does not appeal to the average apprentice. He is primarily interested in the practical application of the principles involved, and he should therefore be started by drawing from the very simplest objects and then slowly be advanced, the various geometrical principles being introduced as he finds it necessary to apply them. The instructor too often makes the mistake of advancing the work too rapidly, forgetting that the environment and the work done by the apprentice is such that his mind is not as keen as that of a student, that the simplest problems are often difficult for him to comprehend, and it is only by many simple applications that he becomes familiar with them. The same is true of mathematics, and care should be taken that the examples given

are in line with the work done in the shop, so that the apprentice can readily see their practical application. By very gradually leading him on he can gain a fair working knowledge of mathematics and finally, with the simpler principles of algebra, geometry and trigonometry, without knowing that he is dealing with such formidable subjects.

The following extract from a letter recently received requires no comment:

"I am one of the many who take special interest in your journal, not only because of its helpfulness along production-improvement lines, but because of your defense of motive-power men in general who have not yet attained the recognition they rightfully deserve. After seven years of hard work I have attained a general foremanship, but the prospects are such that I am now preparing to duck, study telegraphy and railroad accounting, and go into the operating department."

The list of capable men who have left responsible positions in the motive power department to take more lucrative positions in other fields during the past year and of the promising young men, well equipped for effective work in that department, who have found it to their interest to go into other lines of business is entirely too large. It is true that on some few roads there has been quite a marked improvement of conditions, but the work and responsibilities have increased in a greater ratio. When will the railroads realize the importance of the motive power department and place it on its proper basis? When a man spends years in training himself for a certain class of work something must certainly be wrong when it proves to his advantage to give up his chosen profession and seek other fields. It is strange indeed if the railroad managements can find it to their interest to make the motive power department a training school to fit men for other classes of work and that they can afford to let men go after they have made records so good that the attention of outside parties is attracted to them.

After experimenting for over a year with a large freight locomotive, the boiler of which was fitted with a good-sized combustion chamber, during which time it was run on several different divisions and given the most severe service where boiler conditions were the worst, the motive power department of the Northern Pacific Railroad has found the design so much of a success that they specified combustion chambers bers on the order of 70 locomotives, covering both freight and passenger types, which have recently been delivered. When it is stated that the trouble with leaky flues was 75 per cent. less on the combustion chamber engine, compared with the same design of locomotive not so fitted and working under identical conditions, the reason for this action is easy to understand. It was also found that the opportunity to work on such flues as did leak without removing the brick arch was an advantage not to be overlooked. The engine steamed equally well with the others, hauled the same tonnage, and is capable of making a greater mileage.

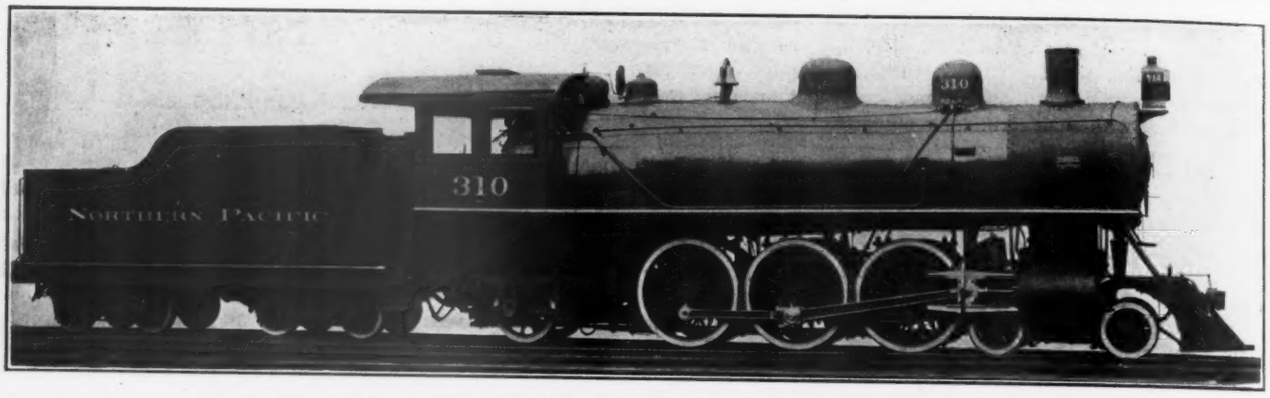
The combustion chamber was used in the original Wooten fireboxes and remained a part of that design until it was found to be of no particular advantage and the engines without it steamed as well and were less expensive to maintain. That experience seems to have been accepted as applying to locomotives burning soft coal, when the wide and shallow firebox was first introduced, and in spite of the accompanying greatly aggravated flue troubles, so far as we know, this is the first attempt to see what results a combustion chamber would give with bituminous coal. There is a great difference in the burning conditions of the two different kinds of fuels, as regards flame length, amount of gas given off, depth of fire-bed, and hence the amount of air admitted, and it would seem unwise to accept the experience on the hard coal burners as applying to locomotives burning soft coal. Judging from the experience on the Northern Pacific, there are decided advantages in this arrangement when used with soft coal which were not evident in its previous trial.

THE SURCHARGE PROBLEM.

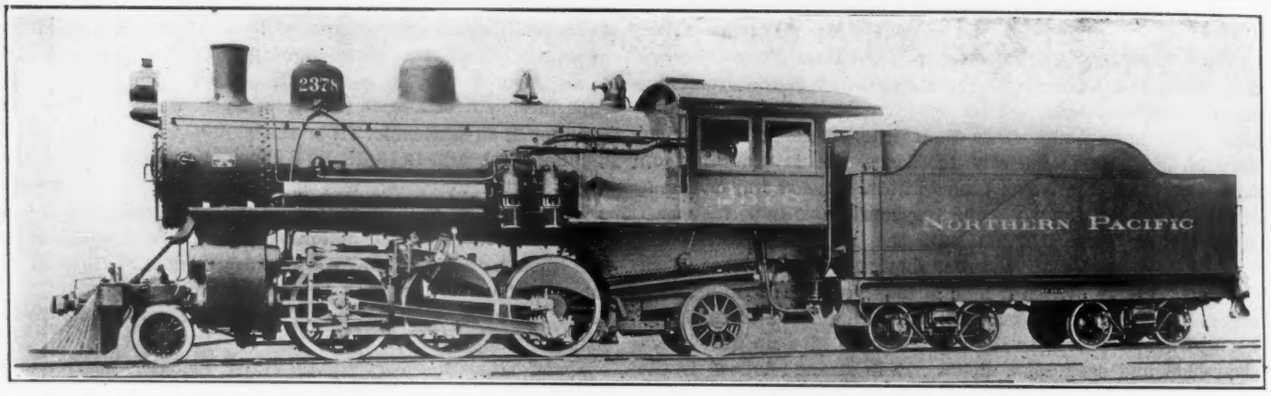
An article which is of the very greatest importance to the motive power department and which should be very carefully studied by all those who are interested in placing railroad shops on the best possible basis, as concerns output and economy, is that by Mr. C. J. Morrison, on "The Surcharge Problem," page 376. The very word "surcharge," or "burden," as it is sometimes called, is a strange one to the average railroad shop superintendent, and even to his superior officers, and yet it is a very common word and one whose significance is readily understood in an up-to-date manufacturing establishment. The manufacturer realizes that the actual cost of labor for making a given article plus the cost of the material is rather a small item compared to what he must sell it for in order to make a reasonable profit. The average shop superintendent, or, to make it more emphatic, the average superintendent of motive power, when he wishes to determine whether it is advisable, from the standpoint of economy, to make a given article in his own shops or to buy it ready made from the manufacturer, will at once proceed to get the data relating to the cost of material and the actual labor cost involved in making the article. These he will add together and then arbitrarily add a certain per cent., either of the labor cost or of the labor cost plus the cost of material, to cover the surcharge; or, as he will doubtless call it, the expense for supervision.

Mr. Morrison has very rightly stated that it is very doubtful if there is more than one railroad in this country that can correctly state the surcharge for any given department. We feel pretty safe in going even farther than Mr. Morrison and stating that it is exceedingly doubtful if the average surcharge for the entire locomotive or car department is either known or understood by one shop superintendent or mechanical superintendent out of ten. As may be seen from Mr. Morrison's figures for a number of shops, the surcharges for a modern railroad shop, and he has very carefully specified what they are as expressed by a percentage of the payroll, amounted, on an average, to 60 per cent. for the locomotive department and 38 per cent. for the car department, although it has been found that the surcharges varied in the different departments of one locomotive shop from 40 to 220 per cent. This will probably be a great surprise to most of the men at the head of our motive power departments, and it will undoubtedly be to their interest to investigate the matter in connection with their own shops. Undoubtedly it will be found that some articles that are being manufactured by the railroad company might be purchased at a less cost to the company and that it will be greatly to their advantage to manufacture certain articles that are now being purchased.

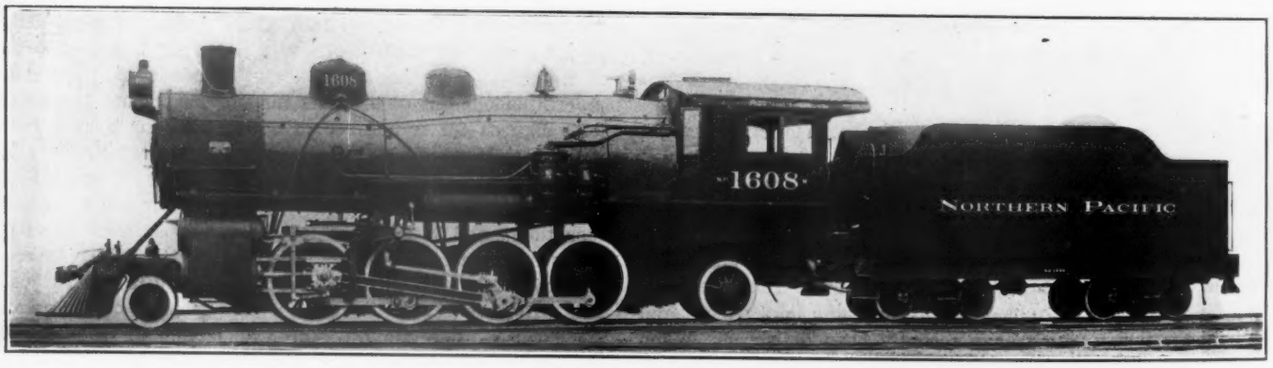
Another exceedingly important question which may readily be solved by a knowledge of the exact amount of the surcharge for each department is the matter of replacing old machine tools by newer ones of greater capacity and improved design. It is not at all uncommon to find that it is necessary to crowd the machine tools in order to have a sufficient number to take care of the output, and yet in the same shop will be found tools, taking up valuable space, that are in poor condition and, in some cases, anywhere from 20 to 50 years old. In a great many instances it ought not to be necessary to even have to go to the length of producing any figures to show that the space occupied by these tools could be used to very much greater advantage by taking them out and replacing them with up-to-date tools; but if those in charge should very carefully and accurately calculate the surcharge on these particular machines it would furnish them with a good, strong and logical argument to present to their superior officers to demonstrate the importance of judiciously improving the condition of the equipment.



PACIFIC TYPE LOCOMOTIVE WITH COMBUSTION CHAMBER—NORTHERN PACIFIC RAILWAY.



PRAIRIE TYPE LOCOMOTIVE WITH COMBUSTION CHAMBER—NORTHERN PACIFIC RAILWAY.



MIKADO TYPE LOCOMOTIVE WITH COMBUSTION CHAMBER—NORTHERN PACIFIC RAILWAY.

FREIGHT AND PASSENGER LOCOMOTIVES WITH COMBUSTION CHAMBERS.

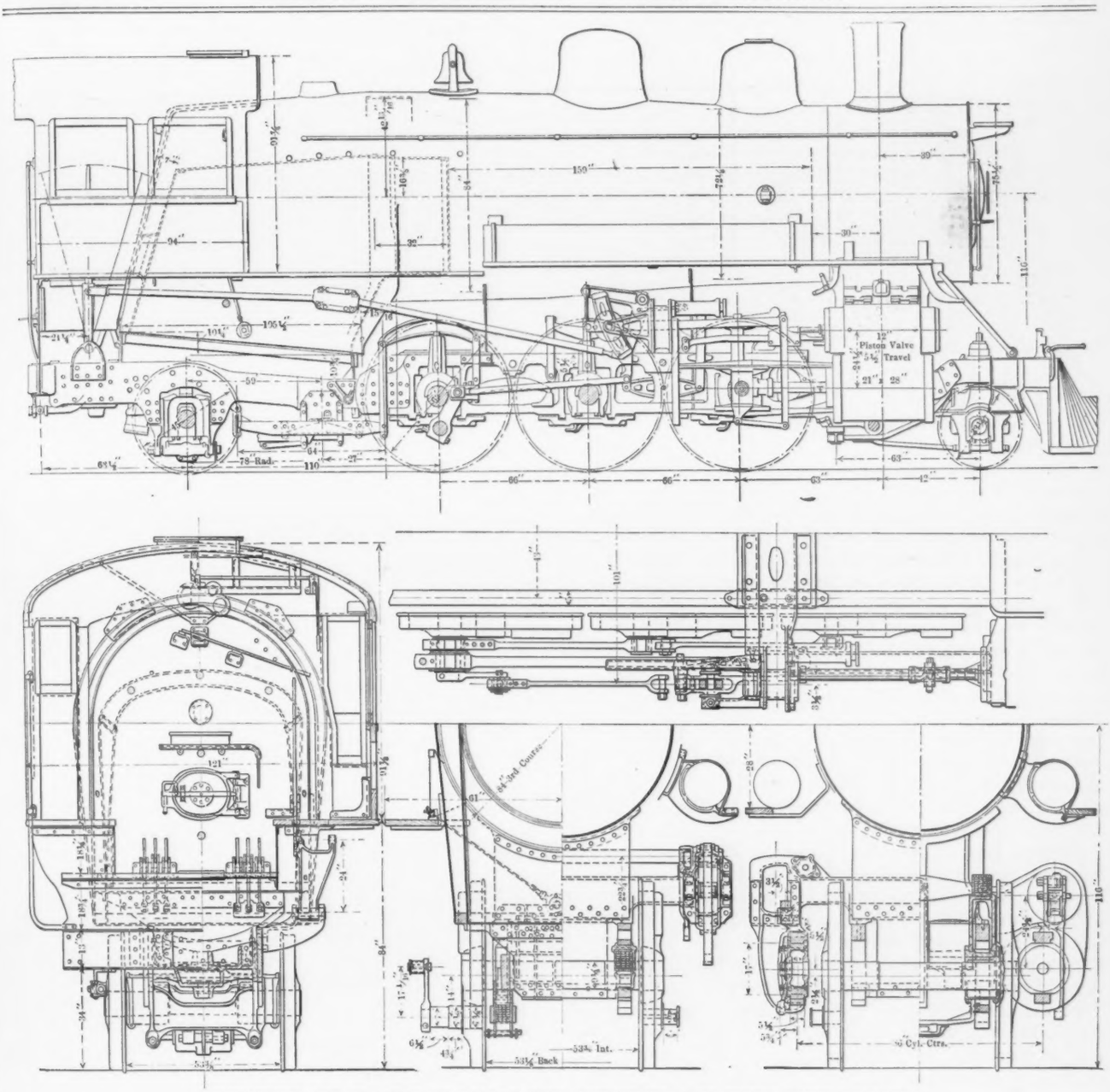
NORTHERN PACIFIC RAILWAY.

The American Locomotive Company during the past few months has delivered an order of 70 locomotives to the Northern Pacific Railway Company, all of which are fitted with boilers having a combustion chamber. This order is divided between three different types, there being 20 of the Pacific type, 30 of the Mikado type and 20 of the Prairie type. One engine of the Pacific type is fitted with the latest design of Schenectady superheater, and one of each of the other two types is equipped with Walschaert valve gear. The Pacific and Mikado type engines are both identical in design with the locomotives built by the same company for this road a little over a year ago, with the exception of the boilers. The previous order consisted of 25 Mikado type, of which six were tandem compounds and five Pacific type. These engines were illustrated and described in this journal in January, 1905, page 5, to which reference can be made for details.

The boilers on the Pacific type engines already in use, which are known as Class Q1, were 72¼ ins. outside diameter of the first ring, and contained 347 2-in. flues 18 ft. 6 ins. long. They were of the radial stay, extended wagon top type. The changes made in the boilers of these later engines, as can be seen by reference to the illustration, include the introduction of a 3-ft. combustion chamber and a reduction in the number and length of flues. In other respects the boilers are the same. The front flue sheet was set somewhat farther forward, so that it gives flues 16 ft. 9 ins. long, or but 1 ft. 9 ins. shorter than the previous engines, although the combustion chamber is 3 ft. in length. The flues are spaced 1-32 in. farther apart, so that there are but 306, as against 347 in the previous class. The differences in heating surface will be considered later.

In the Mikado type, however, the boiler has not been changed outside of the introduction of the combustion chamber, which shortens the flues by its full length. One of this type of the previous order was fitted with a combustion chamber, and it is the experience obtained by the operation of this engine under the most difficult conditions that has led to the specifying of combustion chambers for this large order.

This is the first of the Prairie type engines to be built for the Northern Pacific Railway, and the one illustrated, as equipped with Walschaert valve gear, weighs 209,500 lbs., of which 152,000 lbs. is on drivers. They have 21x28-in. cylin-



ELEVATIONS AND SECTIONS OF PRAIRIE TYPE LOCOMOTIVES—NORTHERN PACIFIC RAILWAY.

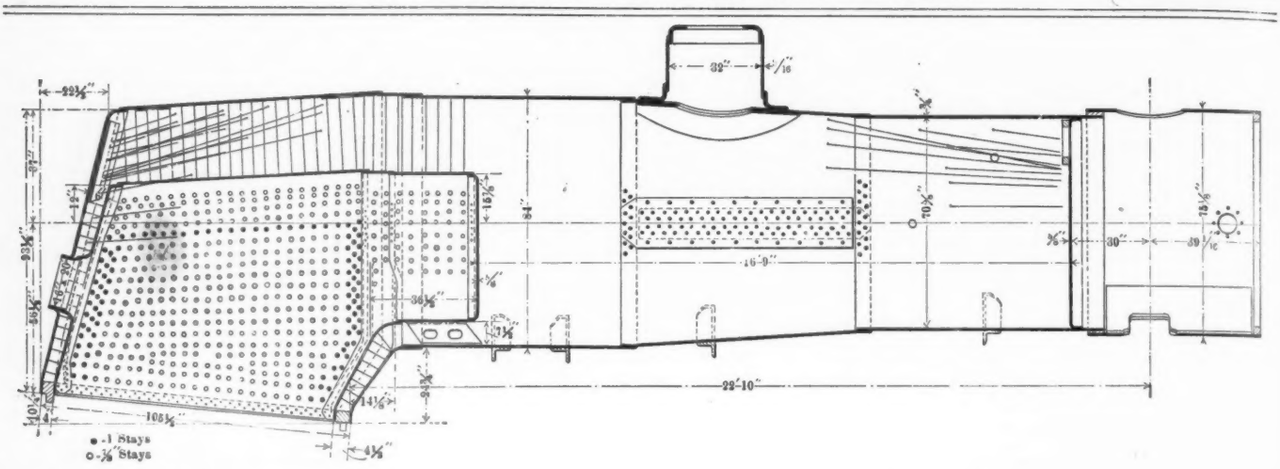
ders with piston valves, and give a tractive effort of 33,300 lbs., the wheels being 63 ins. in diameter. The rigid wheel base is but 11 ft., and since the front axle is but 63 ins. from the center of the cylinder, it made it necessary to connect the main rod to the rear pair of drivers. The boilers of these engines necessarily have short barrels, and the introduction of the combustion chamber, although it is somewhat shorter than on the other two types, shortens the flues to 13 ft. 3 ins., which gives a heating surface in the tubes of but 2,105 sq. ft. Twelve-inch piston valves are used, having a travel of 5 ins. when equipped with the Stephenson motion, and 5½ ins. with the Walschaert gear. The design and arrangement of the Walschaert motion is clearly shown in the illustration.

As mentioned above, one of the Pacific type engines is equipped with the latest design of Schenectady superheater, which will give an opportunity of comparing the performances of three different arrangements of the same locomotive operating under the same conditions, as this road now has a Pacific type locomotive with long flues, without a combustion chamber; the same locomotive with the changes as mentioned, including combustion chamber, and the same engine equipped with superheater and combustion chamber; the design being identical in all respects outside of the boiler.

The accompanying table gives the general dimensions and weights of these locomotives, as well as the early Pacific and Mikado types, and from it comparisons can be made showing the effect of the introduction of the combustion chamber and superheater.

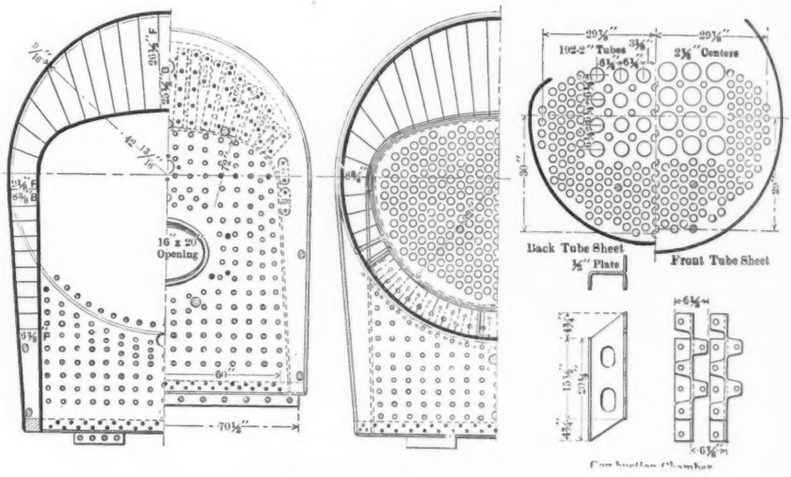
It will be noticed that an equalized type of truck has been placed under the tender of the Pacific type engines which carry 7,000 gals. of water and 12 tons of coal. The tenders of the Mikado type have a capacity for 10,000 gals. of water and 12 tons of coal.

The use of the combustion chamber on wide firebox locomotives burning soft coal is advocated by Mr. David Van Alstyne, mechanical superintendent of the Northern Pacific Railroad, who has probably given the design and service of locomotive boilers greater and more careful study than any other man in the country. His observation has led him to believe that the introduction of the combustion chamber will reduce many of the troubles now found with boilers, especially in bad water districts, and will also be an improvement over the present design in other respects. The advantages claimed for a combustion chamber are the facts that it removes the ends of the flues away from the hottest part of the fire; that it permits working on the flues without removing the brick arch; that it adds materially to the heating surface of the firebox, and also that it gives a largely increased fire



box volume, which will tend toward better combustion.

In order to test the soundness of the theory in a practical way Mr. Van Alstyne specified a combustion chamber on one of the early order of Mikado type locomotives, as mentioned above, which was put into service early in 1905, and has since been operated on several different divisions of the road where boiler troubles were the most numerous and where the water conditions were the worst. The service of this engine was watched carefully, and it was found to be a large improvement. In spite of the fact that there had been a considerable reduction in actual heating service, the engine was found to steam equally well with those having a greater actual heating surface, and, furthermore, this engine required only about one-quarter as much work to be done on the flues, and that on a division where the water conditions were notoriously bad. What work was necessary on the flues could be done without removing the brick arch, which is an economy not only in money, but in time as well. It was also found that there was no collection of cinders in the combustion chamber and that the flues were all open. That the service of this engine was eminently satisfactory from all standpoints is best evidenced by the fact that combustion chambers have been specified on all of this last order of 70 engines, which include passenger as well as freight engines.



BOILER WITH COMBUSTION CHAMBER, PACIFIC TYPE LOCOMOTIVE—NORTHERN PACIFIC RAILWAY.

The general construction and arrangement of the combustion chamber can be seen by reference to the illustration showing the section of the boiler designed for the Pacific type locomotives. The ring forming the chamber is radially stayed from the boiler shell on the upper section, and is supported and stiffened by specially designed plates set longitudinally between it and the shell at the bottom and part way up the sides. The chamber has a clearance for circulation of 7½ ins. at the bottom, narrowing to 7 ins. at the closest point at the sides, which will probably prove to be sufficient to furnish the required circulation for the firebox side sheets and back head. The inner throat sheet meets the combustion chamber ring in a curve of long radius, and the brick arch occupies its usual position from the throat sheet diagonally upward.

Reference to the accompanying table I. will show the reduction of actual heating surface which the combustion chamber has made in both the Pacific and Mikado types. It is well known that a square foot of heating surface in the firebox is much more valuable than an equal area in the flues, and table II. is given showing various ratios with both actual and equated heating surface. Taking the Mikado type as an example, for in this case the number and location of the flues has not been changed and they have been shortened for the full length of the combustion chamber, it will be seen that its introduction has reduced the amount of tube heating surface from 3,798 sq. ft. to 3,192 sq. ft., or 16 per cent., and at the same time the firebox heating surface has been increased

Type	Pacific Without	Pacific With	Mikado. Without	Mikado With.	Prairie With
Combustion chamber	4.6	4.72	4.2	4.4	4.55
Weight on drivers ÷ tractive effort	7.1	7.2	5.55	5.4	6.3
Total weight ÷ tractive effort	40.4 lbs.	49.2 lbs.	48.3 lbs.	59.5 lbs.	65 lbs.
Weight on drivers ÷ total heating surface	62.0 lbs.	75 lbs.	63.5 lbs.	75.9 lbs.	89.5 lbs.
Total weight ÷ total heating surface	81	68.5	93.5	79	53 8
Total heating surface ÷ grate area	4.34	5.53	4.8	5.62	5.4
Firebox heating surface ÷ grate area	5.35 %	8.1 %	5.15 %	7.15 %	10.1 %
Firebox heating surface ÷ total heating surface	965.3 sq. ft.	910.6 sq. ft.	1,070.2 sq. ft.	1,030 sq. ft.	813.3 sq .ft.
Equated heating surface = (tube H. S. ÷ square root of the length tubes in ft.) + firebox H. S.	148 lbs.	161 lbs.	183 lbs.	199 lbs.	186.5 lbs.
Weight on drivers ÷ equated heating surface	22.2	21	24.6	23.7	18.7
Equated heating surface ÷ grate area	607	720	720	835	900
Tractive effort x diam. drivers ÷ actual heating surface (B. D.)	2,220	2,350	2,740	2,890	2,580
Tractive effort x diam. drivers ÷ equated heating surface	11.4 cu. ft.	11.4 cu. ft	15.7 cu. ft.	15.7 cu. ft.	11.2 cu ft.
Volumn both cylinders	310	261	259	219	209
Actual heating surface ÷ volumn cylinders	84.8	79.8	68.2	65.8	72.6
Equated heating surface ÷ volumn cylinders	3.8	3.8	2.77	2.77	3.89
Grate area ÷ volumn cylinders	111	100.5	117	99	80
Length tubes in inches ÷ diameter in inches					

TABLE II.

WEIGHTS AND DIMENSIONS OF NORTHERN PACIFIC LOCOMOTIVES.

Type	Pacific	Pacific	Pacific	Mikado	Mikado	Prairie
Combustion chamber	Without	With	With	Without	With	With
Superheater	Without	Without	With	Without	Without	Without
Service	Passenger	Passenger	Passenger	Freight	Freight	Mixed
Fuel	Bit. Coal	Bit. Coal	Bit. Coal	Bit. Coal	Bit. Coal	Bit. Coal
Tractive power	31,000 lbs.	31,000 lbs.	31,000 lbs.	46,630 lbs.	46,630 lbs.	33,300 lbs.
Weight in working order	219,000 lbs.	223,000 lbs.	226,500 lbs.	259,000 lbs.	261,000 lbs.	209,500 lbs.
Weight on drivers	142,500 lbs.	146,300 lbs.	147,500 lbs.	196,000 lbs.	205,000 lbs.	152,000 lbs.
Weight of engine and tender in working order	347,000 lbs.	364,800 lbs.	368,300 lbs.	405,500 lbs.	438,800 lbs.	349,000 lbs.
Wheel base, driving	12 ft.	12 ft.	12 ft.	16 ft. 6 ins.	16 ft. 6 ins.	11 ft.
Wheel base, total	33 ft.	32½ ft.	32½ ft.	34 ft. 9 ins.	34 ft. 9 ins.	28 ft. 11 ins.
Wheel base, engine and tender	61 ft. 11 ins.	61 ft. 11 ins.	61 ft. 11 ins	63 ft. 1 in.	63 ft. 1 in.	57 ft. 3½ ins
CYLINDERS.						
Kind	Simple	Simple	Simple	Simple	Simple	Simple
Diameter and stroke	22x26 ins.	22x26 ins.	22x26 ins.	24x30 ins.	24x30 ins.	21x28 ins.
VALVES.						
Kind	Piston	Piston	Piston	Piston	Piston	Piston
Gear, type	S.	S.	S.	S.	W.	W.
Greatest travel	6 ins.	6 ins.	6 ins.	5⅝ ins.	5½ ins.	5½ ins.
Outside lap	.....	1 in.	1 in.	.....	1⅛ ins.	1⅞ ins.
Inside clearance	.....	⅛ in.	⅛ in.	.....	0	0
Lead in full gear	.....	L. & L.	L. & L.	.....	5-16 in.	5-16 in.
WHEELS.						
Driving, diameter over tires	69 ins.	69 ins.	69 ins.	63 ins.	63 ins.	63 ins.
Driving, thickness of tires	3½ ins.	3½ ins.	3½ ins.	3½ ins.	3½ ins.	3½ ins.
Driving journals, main, diameter and length	9½x12 ins.	9½x12 ins.	9½x12 ins.	10x12 ins.	10x12 ins.	9½x12 ins.
Driving journals, others, diameter and length	9x12 ins.	9x12 ins.	9x12 ins.	9½x12 ins.	9½x12 ins.	9½x12 ins.
Engine truck wheels, diameter	33½ ins.	33½ ins.	33½ ins.	33½ ins.	33½ ins.	33½ ins.
Engine truck, journals	6x11 ins.	6x11 ins.	6x11 ins.	6½x12 ins.	6½x12 ins.	6½x12 ins.
Trailing truck wheels, diameter	45 ins.	45 ins.	45 ins.	45 ins.	45 ins.	45 ins.
Trailing truck, journals	8x14 ins.	8x14 ins.	8x14 ins.	8x14 ins.	8x14 ins.	8x14 ins.
BOILER.						
Style	E. W. T.	E. W. T.	E. W. T.	E. W. T.	E. W. T.	E. W. T.
Working pressure	200 lbs.	200 lbs.	200 lbs.	200 lbs.	200 lbs.	200 lbs.
Outside diameter of first ring	72⅛ ins.	72⅛ ins.	72⅛ ins.	75¾ ins.	75¾ ins.	72⅛ ins.
Firebox, length and width	96x65¼ ins.	96x65¼ ins.	96x65¼ ins.	97x66 ins.	96x65¼ ins.	96x65¼ ins.
Firebox, water space	.....	4½ & 4 ins.	4½ & 4 ins.	.....	4½ & 4 ins.	4½ & 4 ins.
Tubes, number and outside diameter	347-2 ins.	306-2 ins.	192-2 ins.	374-2 ins.	372-2 ins.	306-2 ins.
Tubes, superheater, number and diameter	.....	.....	24-5 ins.	.....	.....	.....
Tubes, length	18 ft. 6 ins.	16 ft. 9 ins.	16 ft. 9 ins.	19 ft. 6 ins.	16 ft. 6 ins.	13 ft. 3 ins.
Heating surface, tubes	3,339.4 sq. ft.	2,736.7 sq. ft.	2,196.37 sq. ft.	3,798 sq. ft.	3,192 sq. ft	2,105 sq. ft.
Heating surface, firebox	188.8 sq. ft.	241.7 sq. ft.	242.31 sq. ft.	209 sq. ft.	245 sq. ft.	235 sq. ft.
Heating surface, total	3,528.2 sq. ft.	2,978.4 sq. ft	2,438.68 sq. ft.	4,007 sq. ft.	3,437 sq. ft.	2,340 sq. ft.
Superheater heating surface	.....	.....	341.15 sq. ft.	.....	.....	.....
Grate area	43.5 sq. ft.	43.5 sq. ft.	43.5 sq. ft.	43.5 sq. ft.	43.5 sq. ft.	43.5 sq. ft.
Smokestock, diameter	18 ins.	18 ins.	18 ins.	20 ins.	20 ins.	18 ins.
Smokestack, height above rail	15 ft. 5½ ins	15 ft. 5½ ins	15 ft. 5½ ins	15 ft. 10½ ins	15 ft. 10½ ins	15 ft. 8½ ins
Center of boiler above rail						
TENDER.						
Tank	Water bottom	Water bottom	Water bottom	Water bottom	Water bottom	Water bottom
Frame	13-in. chan.	13-in. chan.	13-in. chan.	13-in. chan.	13-in. chan.	13-in. chan.
Wheels, diameter	33½ ins.	33½ ins.	33½ ins.	33 ins.	33 ins.	33 ins.
Journals, diameter and length	5½x10 ins.	5½x10 ins.	5½x10 ins.	5½x10 ins.	5½x10 ins.	5x9 ins.
Water capacity	6,000 gals.	7,000 gals.	7,000 gals.	8,000 gals.	10,000 gals.	7,000 gals.
Coal capacity	12 tons	12 tons	12 tons	12 tons	12 tons	12 tons

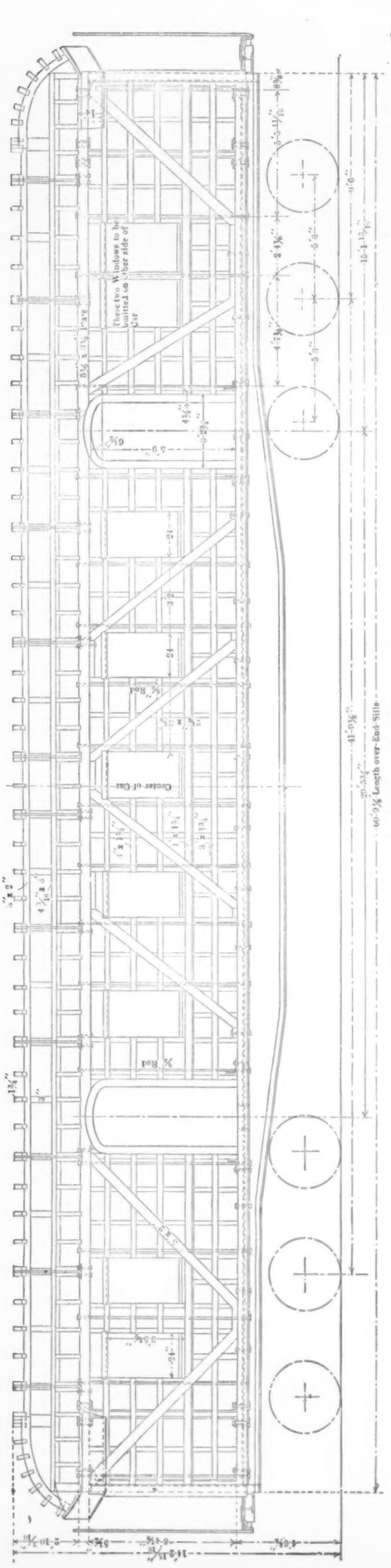
TABLE I.

from 209 sq. ft. to 245 sq. ft., an increase of 16.2 per cent. This increases the percentage of total heating surface in the firebox from 5.15 per cent. to 7.15 per cent. The firebox volume has been increased from approximately 260 cu. ft. to 322.5, or 24 per cent., and as this has all been added ahead of the brick arch it should aid materially in the thorough mixing and burning of the gases. By the formula derived by Mr. H. H. Vaughan from Petiet's experiments for the relative value of flue and firebox heating surface, which equates the total firebox heating surface to the total flue heating surface divided by the square root of the length of the flues in feet, we find that the total equated heating surface has been reduced but 39.4 sq. ft., or 3.7 per cent., which is undoubtedly more than offset by the improved combustion conditions. This being the case, it would appear that the steaming factors of the two boilers are on a par, and that there is a net gain of reduced flue leakage by the removal of the flue ends from the hottest part of the furnace; the opportunity to reduce back pressure by using a larger nozzle because of the shorter flues and the ability to work on the flues without removing the brick arch.

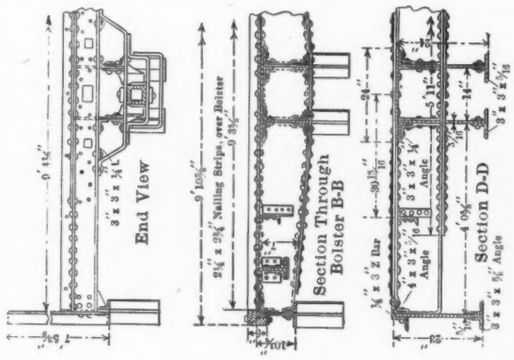
RAILROAD Y. M. C. A.—We also feel that we should say something as to how these men should be cared for at terminals, to improve their mental as well as social standing. We believe that good, clean rest rooms should be provided at terminals to encourage cleanliness with our men. We also believe that they should have access to reading rooms or libraries, where they can keep themselves posted on the leading topics of the day, mechanical and otherwise. Your chairman is fortunate enough to be employed on a road that has a Railroad Y. M. C. A. at each terminal. At one of the associations there is a large library, and members of any of the other associations can draw books from this library, the books being handled back and forth by the railroad company free of cost. At all of the associations there are good, clean rest rooms, and at several of the away-from-home terminals there are lunch rooms; and we would heartily recommend the Railroad Y. M. C. A. to any railroad, as we know of nothing that will improve the standard of the men, from a moral or social standpoint, more than the installing of these institutions.—*Report of Committee on "The Future Engineer," before the Traveling Engineers' Association.*

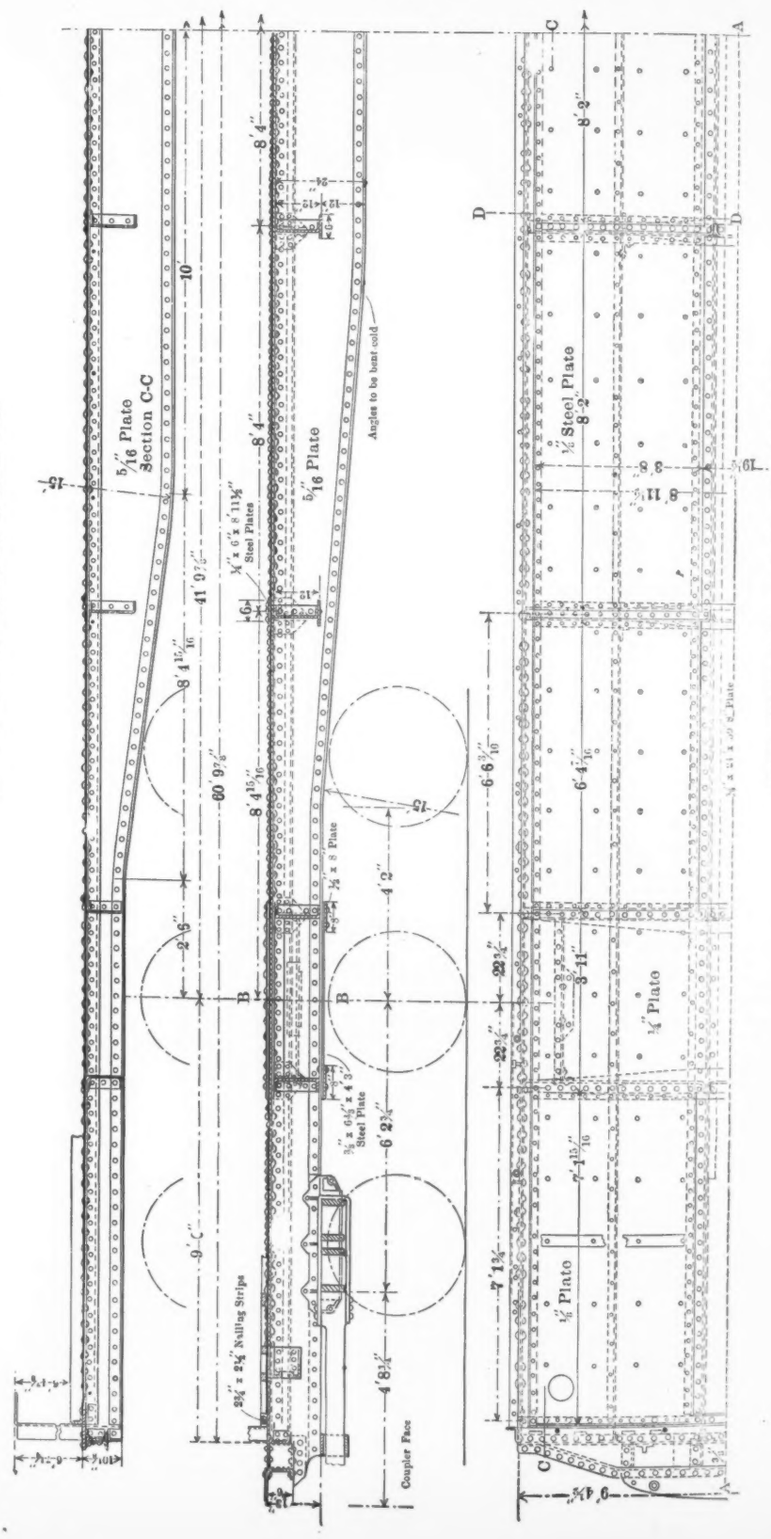
THE COST OF RAILWAY OPERATION.—The increase in the cost of railway operation is well shown by figures compiled by Mr. H. T. Newcomb. In 1899 it cost $856,968,999 to operate the railways of the United States; in 1903 the same expenses amounted to $1,257,538,862, an increase of $400,569,863. In 1899 railway labor, exclusive of salaried employees, received $481,264,109; in 1903 the same classes received $720,580,923, an increase of $239,316,814. In 1899 the fuel used by locotives cost $77,187,344; in 1903 it cost $146,509,031, an increase of $69,321,687. Comparing operating expenses with work done, it appears that in 1899 for every dollar expended for operation the railways were able to carry 17 passengers and 165 tons of freight one mile. In 1903 the passenger mileage for each dollar expended in operation amounted to 16.6 and the freight mileage to 138. Each $1 of operating expenses in 1899 brought in $1.53 in revenue, not including that from miscellaneous services, while in 1903 it brought in $1.38 only. —*The Engineering Record.*

WATERPROOF GLUE.—A waterproof glue may be made from three parts of gum shellac and one part of India rubber, these being dissolved separately in ether under the influence of heat, and the two solutions mixed and kept for a time in a sealed bottle. Water, either hot or cold, and most acids and alkalies will have no effect on the glue.—*The Iron Age.*

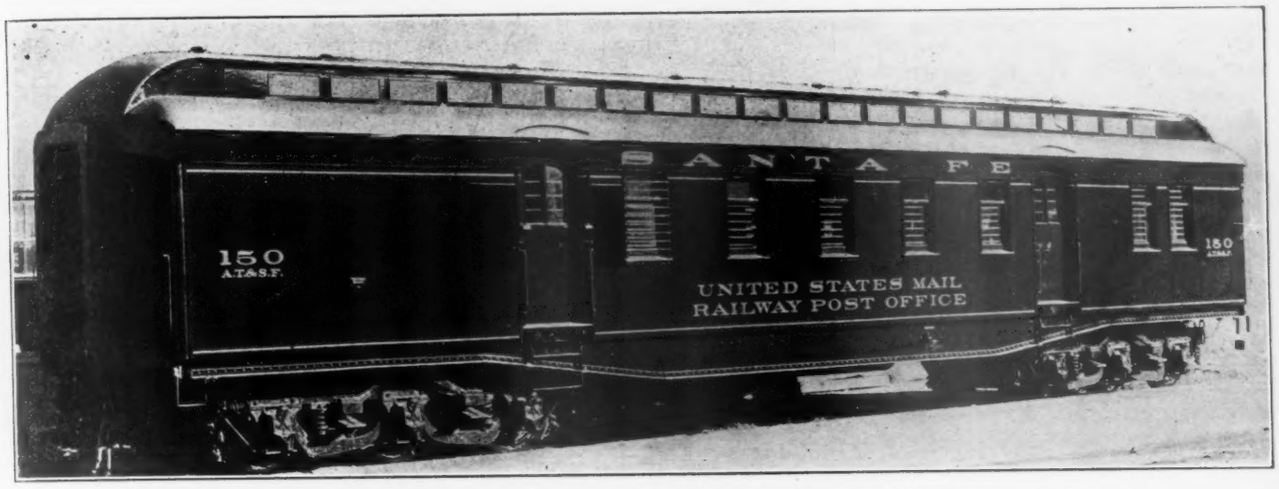


SIDE FRAMING OF SANTA FE POSTAL CAR.





STEEL UNDERFRAME OF SANTA FE POSTAL CAR.



POSTAL CAR WITH STEEL UNDERFRAME—SANTA FE SYSTEM.

STEEL UNDERFRAME POSTAL CAR.

SANTA FE SYSTEM.

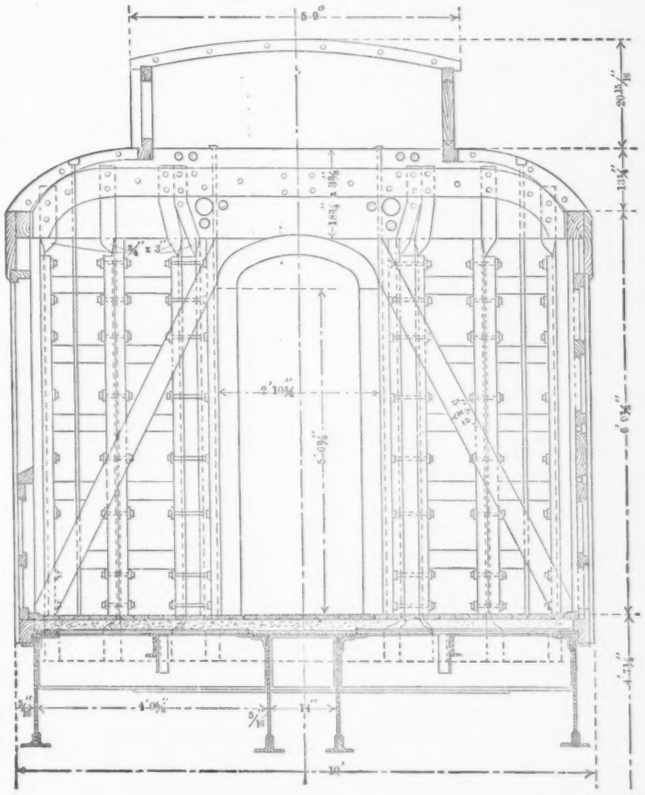
About a year ago the Santa Fe placed in service 39 steel underframe postal cars, which have given very satisfactory results since being placed in operation. The general dimensions of these cars are as follows:

Length over end sills	60 ft. 9⅞ ins.
Length inside	60 ft.
Width over sills	9 ft. 10⅝ ins.
Width inside	9 ft. 2 ins.
Height, top of floor to top of plate	6 ft. 9½ ins.
Height, floor to ceiling	9 ft. 4⅞ ins.
Height, top of rail to top of roof at center	14 ft. 3⅝ ins.
Weight, fully equipped, about	105,000 lbs.
Weight of steel underframe	20,000 lbs.

The center sills are continuous for the full length of the car, and consist of 5-16-in. open hearth steel plates reinforced at the bottom by two 3x3x5-16-in. angles, as shown, and at the top, on the outside only, by a 3x3x¼-in. angle. They are 24 ins. deep at the center for a distance of about 10 ft., tapering to 13 ins. at the bolster. They are covered by a ¼-in. steel plate 24 ins. wide and 59 ft. 8 ins. long, to which they are securely riveted. The side sills consist of 5-16-in. steel plates reinforced by two 3x3x⅜-in. angles at the lower edge and by a ¼x3-in. Z bar and a 4x3x5-16-in. angle at the top They are 23 ins. deep at the middle and 10⅛ ins. deep at the bolsters. A 3⅜x5-in. wood sill is supported by the Z bar, as shown on the drawing.

The space between the center and the side sills is covered by ⅛-in. steel floor plates riveted to the edges of the center sill cover plate and to the top angles of the side sills. In addition the floor plate is supported and stiffened by a 5-in., 6.5-lb. channel extending lengthwise and about halfway between the center and side sills. Nailing strips, 2¼x2¾ ins., are bolted to the floor plate by ½-in. bolts. The four sills are securely tied transversely by pressed steel diaphragms ¼ in. thick. These diaphragms are reinforced at the top by ¼x6-in. steel plates extending the full width of the car, and are stiffened and tied at the bottom by ¼x6-in. plates 5 ft. 11 ins. long, which pass through openings cut in the webs of the center sills and are riveted to the lower edges of the diaphragms.

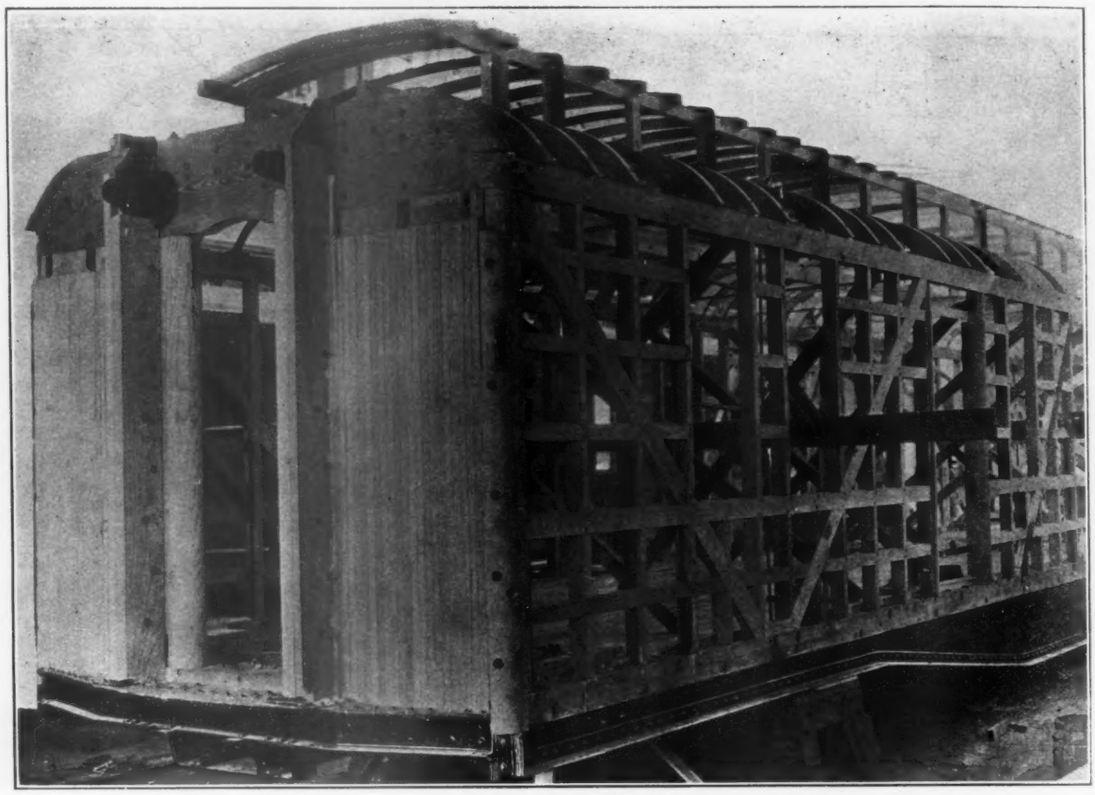
The body bolster is formed of two pressed steel diaphragms ⅜ in. thick, with the flanges turned outward, and spaced 3 ft. 6 ins. back to back. These diaphragms are riveted to the center and side sills, and each set is tied at the bottom similar to the cross ties, except that the plates widen to 8 ins. where they are riveted to the center sills. The entire bolster



END FRAMING OF POSTAL CAR.

is covered with a ¼-in. plate 4 ft. 3 ins. wide by 8 ft. 11 ins. long, which is riveted to the tops of the diaphragms and to the center and side sills by ¾-in. rivets. The center plates are of cast steel, and the side bearings are of hardened steel plate riveted to the bottom flange of the 7-in. channel extend-

STEEL UNDERFRAME OF POSTAL CAR.



FRAMING OF SANTA FE POSTAL CAR.

ing between the two bolster diaphragms and to a 3x3x¼-in. angle, which is riveted to the back of the channel.

The webs and top flanges of the center sills are cut away at the ends to a depth of 6 ins. and in line with the ends of the side sills. A 6-in., 10.5-lb. channel is secured across the ends of the sills with flanges in and with its back 11 ins. from the end of the center sills. The end sill consists of this member and a bent 6-in., 8-lb. channel, 7 ins. from it and parallel to it for a distance of 4 ft. 10 ins. These two channels are tied together by four pressed steel diaphragms, two of which are in line with the center sills. The ends of the outer channel bend back to meet the inner channel at the side sills. These end sill channels are riveted to the center sill cover plate, and a heavy cast steel buffer beam is secured to them. A wooden sill for attaching the underframe is secured to a 2½x2½x5-in. angle riveted to the tops of the longitudinal sills back of the end sill.

Yellow pine flooring ⅞ ins. thick is secured to the nailing strips, which are bolted to the floor plate, and the space between this and the sub-floor is packed with mineral wool.

The side posts are 2¼x3⅜ ins., and the first and third posts from the end of the car are plated on both sides with ⅜x2½-in. iron. The corner posts are secured to the corner angle by ½-in. bolts. The post rods are ⅝ in. in diameter with the nuts riveted over. The end posts consist of 2¼x4⅛-in. long leaf yellow pine, and are plated on both sides with ¾x3-in. iron. The iron carlines, 12 in number, are ¾x2 ins., the T foot being secured to the side plates with ½-in. bolts.

The cars are equipped with the Santa Fe standard six-wheel trucks, with 5x9-in. journals, Chicago Railway Equipment Company's frictionless side bearings, Miner draft rigging, National couplers, and Symington journal boxes.

The cars were built at the St. Charles works of the American Car & Foundry Company. We are indebted to Mr. A. Lovell, superintendent of motive power, and to Mr. E. Posson, engineer of car construction of the Santa Fe, for information.

No Passenger Killed in 31 Years.—The Canadian division of the Michigan Central R. R. has not had an accident in which a passenger was killed during the thirty-one years of its existence.

DISCIPLINE IN THE BLACKSMITH SHOP.*

By A. W. McCaslin.

We cannot discipline others if our own education along the same line has been neglected; neither can we secure and retain in our shops sober, honest, industrious, right-thinking men, and live in opposition to right principles ourselves. We are seen as we are; either irritable, untruthful, intemperate, profane, unscrupulous, or affable, truthful, clean-mouthed, appreciative, progressive, fair-minded.

Discipline does not mean gruffness, harshness, or a long face and knitted brow; but rather the reverse, and, when accompanied with the right spirit or proper understanding is generally productive of a kindly feeling between the foreman and the workman.

We cannot have discipline without system; we cannot have a good system without classification; we cannot have classification of the work without classification of the men; we cannot classify either the men or the work without a thorough practical knowledge of our business. These qualifications or requisites are only attainable through an experience that includes the solving of each problem in shop requirements correctly as it is presented to us; and through the ability to read human nature and readily distinguish the character of men, not only in their aptitude toward mechanics generally, but in their disposition as well, whether optimistic (with the resultant upbuilding influence on associates and fellow-workmen) or the opposite, that is, pessimistic; a word that causes one to feel like rinsing his mouth after speaking it.

Classification of the work makes the workman responsible for, and consequently much more careful with his work. While it is necessary that a certain number of items or pieces be made in a certain number of hours, they should be made perfect. When a certain number of articles are produced by one workman, and a duplicate order by another, the responsibility of failure or breakage while in service is not easily placed. This fact is frequently taken advantage of in the use of the fuller, or hammer pean, to hide defects that the fore-

*Abstract of a paper read before the International Railroad Blacksmiths' Association Convention.

man or inspector, whoever he may be, cannot detect. But if a certain class of work is the work of a certain workman and is "his" work not only while in the shop, but also while in the service, he will not fuller shut a goulded corner or pean the point of a loose scarf or a cold shut or an overlap in a fillet.

To have a good system we must have uniform or established methods of production. This is one of the fundamental necessities to the greatest and best output in any railway shop, and will help to remove thoroughly the cause for any foreman having to exaggerate at home or abroad as to the output of his shop. And if we do not exaggerate, the other fellow will have less inducement to "stretch" matters a little farther in his pneumatic efforts to exceed, and this would keep us all out of trouble with our veracity unscarred.

MAKING GOOD SMITHS.

The best interests of the company are served by making our own blacksmiths either by apprenticeship or by promoting bright, ambitious helpers. The writer's experience has led him to prefer the latter as the best material from which to make profitable blacksmiths for the company, and at the same time help those who are anxious to help themselves and serve their employers.

In promoting helpers we have our pick and choice from many who have already given evidence of making just such men as we need to handle the work in a smith shop. And I wish to say, while on this subject, for the benefit of those whose business it is, that when these men educated in our shops become first-class workmen, they should receive first-class wages and not be permitted to accept a position elsewhere for the sake of ten or fifteen cents per day, while a stranger, an inferior workman, is given the position and the rate of pay the other man could not obtain.

Very seldom are the tools and mehods of working in other shops such as would, if adopted, improve our own best method of operating our shop. Please understand this correctly; we do not mean to say that the perfect system in the small shop would answer as a perfect system in the larger shop; neither would the perfect system in the large shop be the best or most profitable in the small shop. These facts are the arguments in favor of making our own workmen, for as a rule workmen educated under a system differing from our own are not profitable to the company nor to themselves until they become acquainted with the tools and methods of working in our particular shop—quality and quantity of output considered. Yet, when the exception to this rule occurs, and it does sometimes, though infrequently, dividends are increased through the better methods of production; this point is only one of the many that should be promptly recognized by the wideawake foreman who wishes to operate his shop successfully. Better ideas of others should not escape us, while ideas of less merit than our own should be disregarded.

The following are also a few of the arguments in favor of making and retaining our own workmen: they know the foreman, his disposition, ambition, etc., and are unconsciously governed accordingly; while the foreman does not only know the dispositions and abilities of his own men, but recognizes their weak points as well, and in helping them overcome these makes them better men to themselves as well as better and more profitable men for the service of the company. They (our own men) know every tool in the shop, know where it is kept and have used or seen it used; they know the established daily output of the tool or tools and again are governed accordingly. We will also have less labor trouble with men educated in our own shop than with the itinerant mechanic whose employment may make a parallel to the case of one rotten apple spoiling every other apple in the barrel. In explanation and qualification of the last statement, will say, if we engage several workmen from as many different shops, permitting each one to bring with him the discipline, time for doing the work and the ideas of quality that govern these points in the shop each one came from, our shop system will speedily become demoralized.

SPECIAL MACHINES.

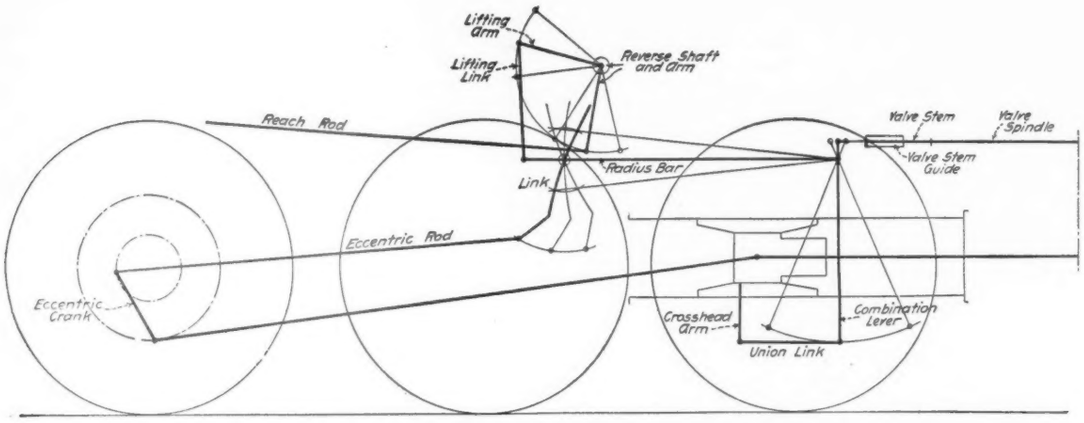
We frequently hear foremen in the medium or small shops complain that they cannot compete in the cost of output with the large shops that have special machines with which to do their work. Yet they do not have to meet the prices of the special machine men on special work to be equally as profitable to their companies. In large shops on large systems where the different items are made by the thousands to supply all the repair points with the necessary material, special machines are profitable and necessary, but in the small or medium shop there are generally just enough men to take care of the jobbing or running repairs when the demands are greatest. This demand is not constant or regular. The requirements of to-day call for our best efforts and no false movements; to-morrow there will not be sufficient repair work to keep the men employed at the same speed as yesterday, and every man that can be spared from the repair work at any time should be placed immediately on the special or new work with such tools as we may have, the steam hammer and possibly one or two other machines. It would not be very profitable to install costly special machines in such cases with which to produce the work while slackening speed or letting the men rest or kill time until another rush of repair work called for more activity.

Without system and much thought in the allotment of work for bulldozers, heading machines, etc., there will be much time lost. Orders for items to be produced by machines should be large enough to try the capacity of the machine for at least one-half day or one or two full days, sufficient to meet all demands for that item in the next thirty days. All similar work should follow in turn, avoiding as much as possible the most complicated tools as well as the changing of furnaces. We recognize the fact that with special machines new work may often be produced for less money than the old item can be repaired. Yet, on most or many of our railroads, the repairs to foreign cars is quite an item, and it would be impossible, at least not profitable, to have machines for producing this class of work in the new, there being scarcely two duplicate pieces called for in the same day.

Admiral Togo's victories were not won by a preponderance of armament, but by superiority of skill. It is not in the possession of a surplus of special or individual power machines alone that our success and the success of our shop depend, but rather in our brain power or ability to supply a limited number of power machines with sufficient easily adjustable formers, dies, etc., so that each machine may be utilized for a multitude of purposes.

To obtain the best results in the railway smith shop, or in fact in any shop, there are many things the foreman should not do which are almost equal in importance to the things he should do. He should not be gruff with his men; he should not have those who are termed "pets" in his shop; neither should he show partiality; he should not speak lightly of any one of his men to another, or even to make possible inference to his discredit, for such a thing is one of the meanest ways of taking advantage of another. The foreman should not try to force impossible results from his workmen, for they will invariably lose confidence in his ability and judgment; neither should he in dealing with his men handle the truth carelessly.

Finally, and in that same old much abused "nutshell," regardless of the particular system under which the smith shop or any other shop is operated, it is absolutely necessary in order to obtain the best results that the foreman prove convincingly to his workmen that he is perfectly familiar with what constitutes proper results in one hour's or one day's work on any item or items given them to do. If this ability in the foreman, gained through an abundance of both experience and common sense, is recognized by the workmen, either voluntarily or through force, there will be no necesssity to change the present system or mode of operation to obtain the best results.



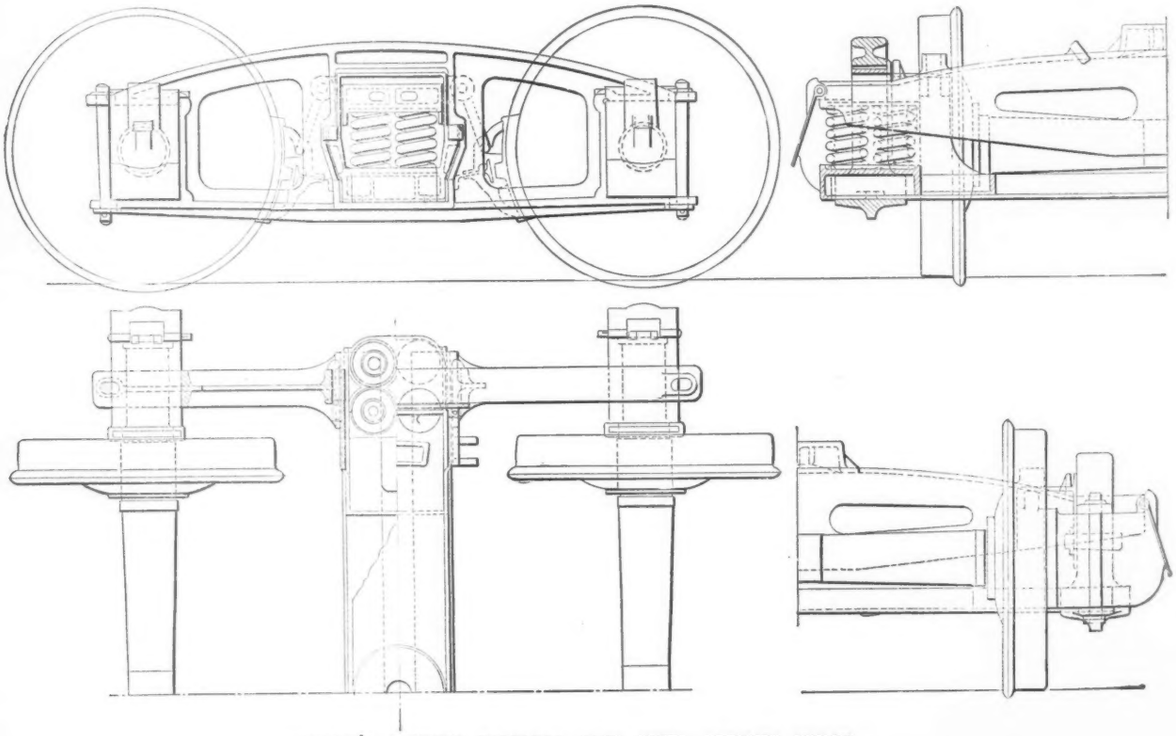
OUTLINE DIAGRAM OF WALSCHAERT VALVE GEAR.

(The names of the parts of the Walschaert valve gear, as designated above, have been adopted as standard by the American Locomotive Company. In view of the extending use of this gear and the various names which have been used to designate different parts, it seems advisable to have a uniformity in this respect and the AMERICAN ENGINEER AND RAILROAD JOURNAL has decided to use the names as given above.)

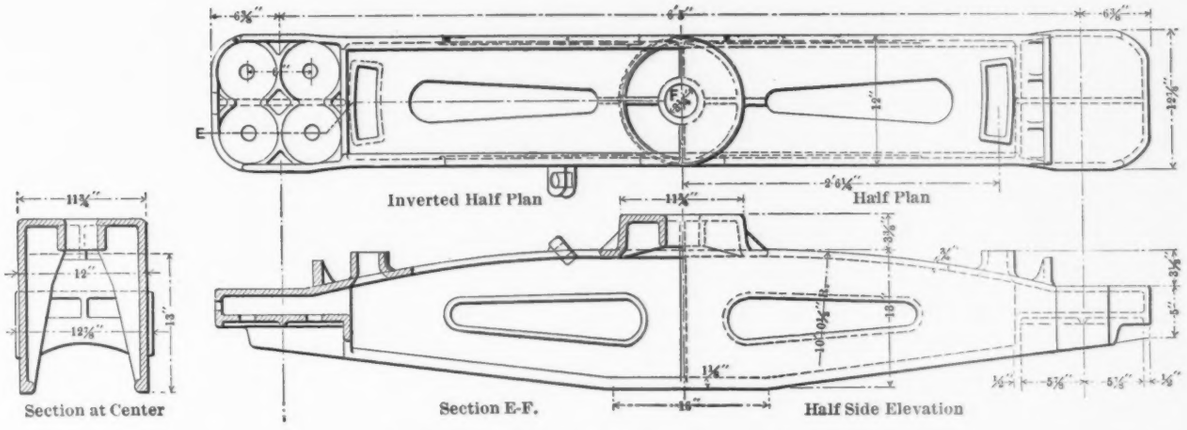
BOLTLESS CAST STEEL FREIGHT TRUCKS.

In 1902 Mr. W. E. Symons, at that time superintendent of motive power of the Plant System, placed in service a number of boltless cast-steel freight car trucks of his own design. These, although of very simple design and of great strength, did not prove flexible enough for the conditions under which they were used. Mr. Symons has recently redesigned these trucks, as shown in the accompanying drawings, to better adapt them to meet service requirements.

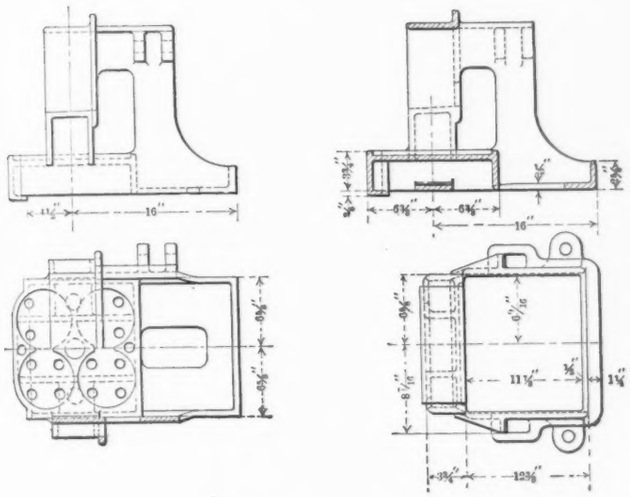
The side frame, of cast steel, is formed in one piece; the journal box jaws are horizontal, and the boxes are retained by heavy wrought iron, semi-circular keys, as shown. Provision has been made for using standard M. C. B. journal boxes, although this is not shown on the drawing. On the earlier design of trucks a one-piece cast steel spring plank was used, but it was found advisable, both because of the reduced weight and the greater flexibility, to use two 5 x 3 x ⅜ in. 9.8-lb. angles, with the shorter legs up, for this purpose. The longer or horizontal leg of the angle has a 1⅜-in. hole 4½ ins. from each end, which fits over bosses cast on the lower bar of the side frames. The spring seat is of cast steel and is slipped in place from the inside of the frame and rests on the two spring plank angles, fitting between the vertical legs and having a lip on the outer side which extends down over the ends of the angles and comes flush with the lower bar of the side frame. The spring seat, which is shown in detail and from which the brake hangers are suspended, is rigidly secured to the side frame by two wrought iron keys driven between it and the sides of the columns. The lower part of this casting, which fits between the spring plank angles, extends inward from the side frame almost 14 inches, thus stiffening the connection of the angles to the side frame and preventing the side frames from getting out of alignment. The angles are still, however, sufficiently flexible to insure freedom from derailment or injurious strains due to an undulating track or poor roadbed. No bolts are used in the construction of the truck and all keys are fitted with cotters.



SYMON'S PIONEER BOLTLESS CAST STEEL FREIGHT TRUCK.



TRUCK BOLSTER—PIONEER CAST STEEL TRUCK.



DETAILS OF SPRING SEAT.

Mr. Symons has also brought out another design, in which the spring seat is cast integral with the side frame, thus eliminating the keys and reducing the weight. Openings for the spring plank angles are cored out below the spring seat, and each angle is riveted at each end of the side frame by three rivets, so placed that they may be removed from either the outside or the bottom of the truck.

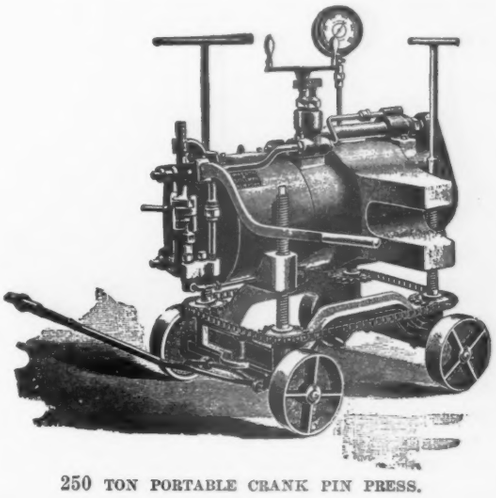
The truck bolster is of cast steel, with the center plates and side bearings cast integral with it. Reference to the drawing will show that the center plate is placed the reverse of that ordinarily used. The truck of this design, for use under 50-ton cars, will weigh approximately 1,690 lbs., including the bolster, which weighs 550 lbs. These trucks have been patented by Mr. Symons and will be manufactured by the Pioneer Cast Steel Truck Company of Chicago, of which he is the president.

250-TON PORTABLE CRANK PIN PRESS.

An exhibit which attracted more than usual attention at the Atlantic City conventions was that of the Butler Drawbar Attachment Company, of Cleveland. A new design of crank pin press made by the Watson-Stillman Company, of New York, was used for testing the Piper friction draft rigging, which was so arranged that the action of the spring and friction parts could be very closely observed as the pressure was increased until they practically came solid under a pressure of 350,000 lbs. The press was used so successfully for this purpose that it has been suggested that it would not only prove of value for use in railroad shop work, but might be used to considerable advantage by railroad companies wishing to test the different types of draft rigging.

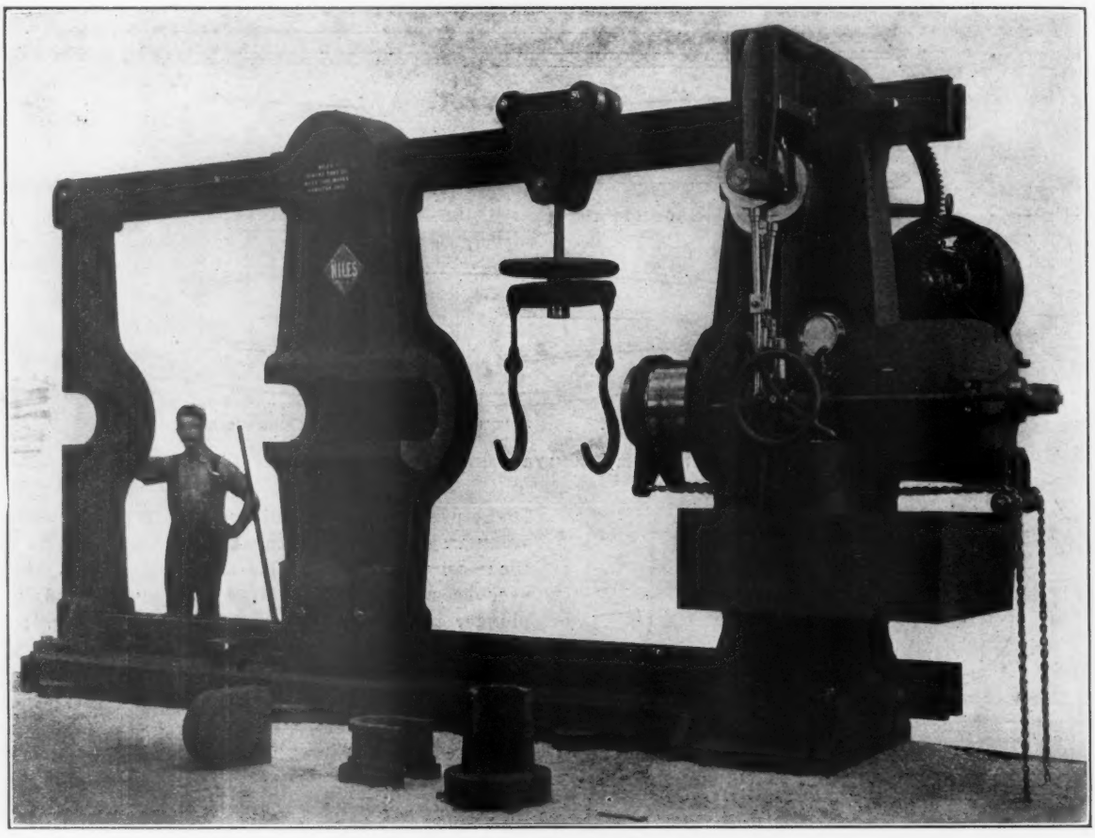
The press, which is equipped with a double pump and a reversing cylinder, has a capacity of 250 tons, and is probably the most powerful portable shop tool of this kind that has ever been built. The large ram is operated by a double plunger pump, the low-pressure piston driving it forward at four times the speed of the high-pressure one, and giving a maximum pressure of 60 tons. A small cylinder for withdrawing the large ram is located above the larger cylinder, and the ram for this is connected to the larger one. A pair of geared screw valves throws the pump delivery to either the pressure or the return cylinder, as may be desired.

The entire tool may be raised or lowered by using a socket wrench on any one of the four elevating screws; or, if desired, the chain may be taken off and each screw be operated independently. The beam and cylinder are made of steel and in one piece, in order to secure lightness. The rod centers are adjustable from 23 to 52 ins., the diameter of the attaching rods being assumed at 4 ins. The center of the large ram is adjustable vertically from 20 to 32 ins. The shipping weight of the machine is about 2,600 lbs.



250 TON PORTABLE CRANK PIN PRESS.

CHICAGO'S FREIGHT TUNNEL.—About 45 miles of the tunnel is now completed, several branches extending well beyond the river on the north and west sides. The present equipment consists of 67 electric locomotives and 400 freight trucks. There are being built an additional complement of 15 locomotives and 250 trucks. The company has 40 receiving stations and is connected with nine regular railroads. The roads now ready for service are the Erie, Alton, Rock Island, Wabash, Santa Fe, Great Western, Monon, Baltimore and Ohio, Chicago, Milwaukee and St. Paul, and contracts have just been entered into between the tunnel company and the Chicago and Eastern Illinois and the Illinois Central.



NILES 600-TON HYDRAULIC WHEEL PRESS.

600-TON HYDRAULIC WHEEL PRESS.

A few years ago a 300-ton wheel press was considered to be sufficiently powerful for all purposes. With the introduction of cast steel driving wheel centers and the use of larger axles under the heavier power it soon proved unsatisfactory, and a more powerful machine was found necessary. Its successor, the 400-ton press, has also been found of insufficient capacity on roads where cast steel wheel centers and axles with wheel fits as large as 10 ins. in diameter are in use, and at the present time there is a demand for a much more powerful machine.

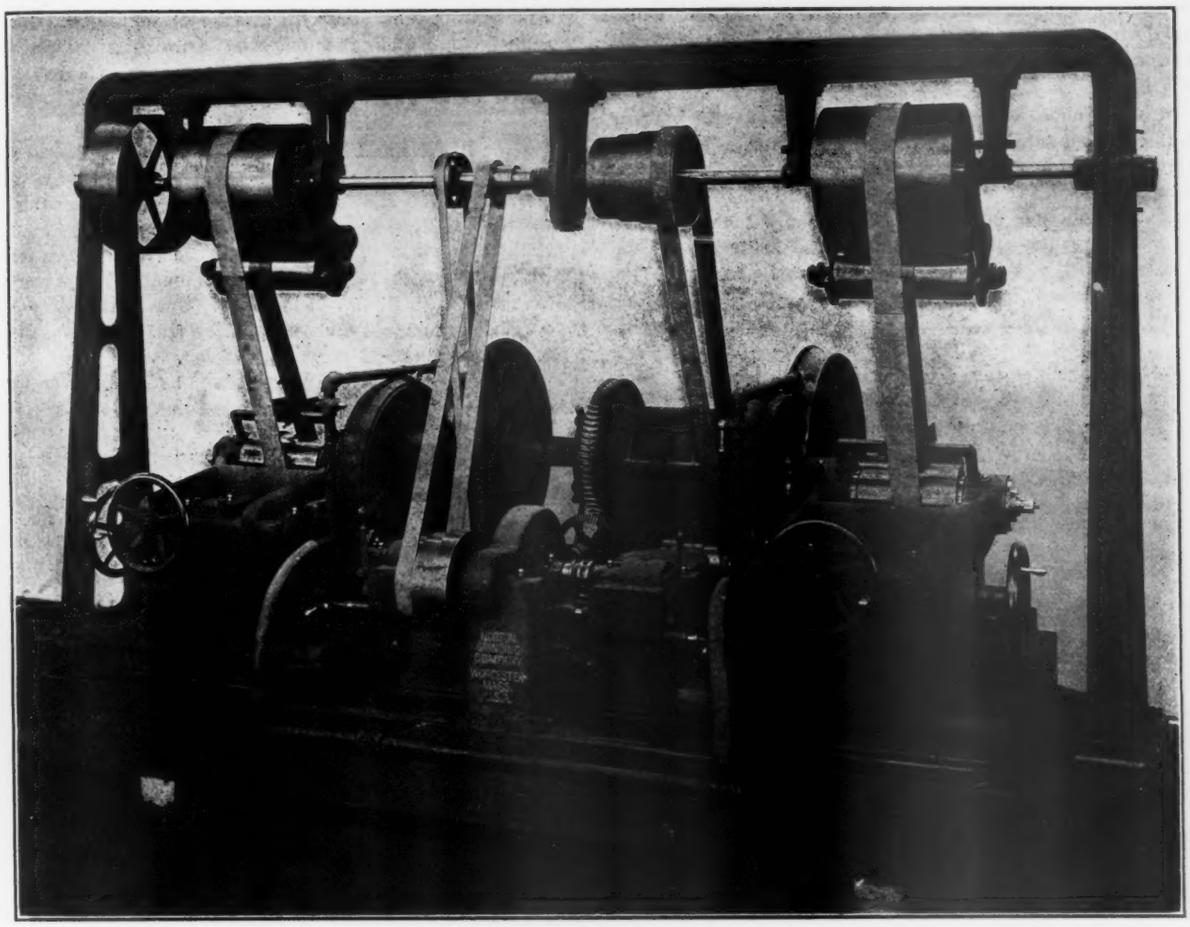
Inquiry among a dozen representative shop superintendents brought out the following facts: Three of them advised that they considered a 400-ton press of sufficient capacity. On one of these roads, however, the pressure required for pressing on driving wheels was considerably less than that used on other roads. Of the other two, one was from a shop where the locomotives are not very heavy, but of average capacity, and this is apparently true of the other one, for a shop superintendent at the other end of the same system, which is a large one, strongly advises the use of a 500 or 600-ton press, and gives some first-class reasons for doing so.

The other nine shop superintendents recommend a capacity of 500 or 600 tons. In one shop an old driving wheel press has been weighted down so that a pressure of 500 tons may be obtained, but in a number of instances it has been found impossible to press the wheels off with this pressure, and it is either necessary to heat the wheel center or to drill the axle or wheel center. In another shop, where a 300-ton wheel press is in use, it has been found impossible, in a majority of cases, to press off the wheels without first applying a gasolene heater. In another shop, where a 300-ton wheel press is in use, which exerts a maximum pressure of 350 tons, it has been found necessary in a great many instances to use the maximum pressure in order to press wheels off of axles with a 9¼-in. wheel fit, and it is estimated that with new power, having axles with a 10¼-in. wheel fit, it will be found necessary to use pressures as high as 450 to 500 tons. In another shop having a 300-ton wheel press it is quite frequently necessary to partially drill out the axle in order to remove the wheels, and the shop superintendent is of the opinion that the wheel press should have a capacity of 500 to 600 tons. In another shop it has in several instances been found necessary to use a pressure of 450 tons and then to start the wheels with a sledge.

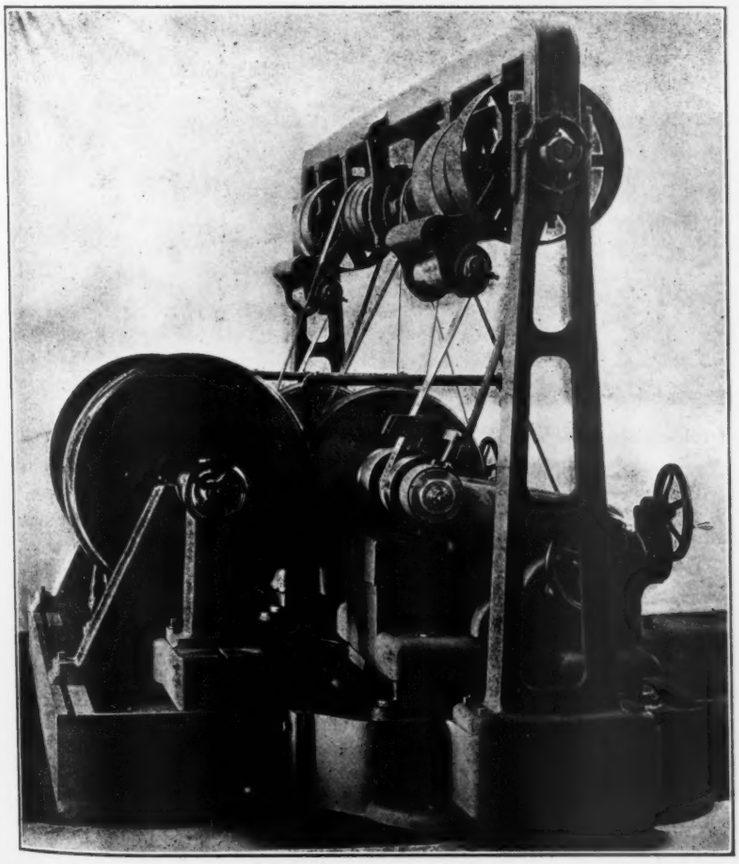
The illustration shows a 90-in., 600-ton Niles hydraulic wheel press, which has recently been placed on the market. The distance between the ram and the resistance post, which is a steel casting, is 8 ft. 3 ins. Four tension bars are used instead of two, and the post is so arranged that its weight is entirely removed from them. The cylinder is of cast steel, and has an outside diameter of 27 ins. The pump has three plungers, and is operated by a 12½-h.p. motor. The machine will take wheels 84 ins. in diameter on the tread, the height between the tension bars being 90 ins.

The machine is mounted on a base plate, but no strains are transmitted to it, as all the pressure is taken by the tension bars. The cylinder is lined with copper expanded into place and burnished. The piston is packed with leather, is tight, durable, and causes very little friction. The ram is counterweighted for a quick return when the release valve is open. The safety valve may be set to open at any desired pressure, and is protected from tampering by a lock box. The pressure gauge is graduated for tons of pressure and for pounds per square inch on the ram. The water tank is bolted underneath the cylinder, taking the discharge and supplying the pumps.

LOCOMOTIVE ENGINEER.—There are few positions in the ordinary walks of life that hold out to the young man of intelligence, equipped with a common school education and a fair amount of muscle, better inducements, either financial or otherwise, than the position of locomotive engineer.—*Committee report on "The Future Engineer," Traveling Engineers' Association.*



NORTON CAR WHEEL GRINDER—FRONT VIEW.



NORTON CAR WHEEL GRINDER—END VIEW.

CAR WHEEL GRINDER.

The Norton Grinding Company, Worcester, Mass., has recently furnished one of the large railroads with two car-wheel grinders of a new design. The new machine is of very substantial design, being built for accuracy and durability, and will grind the car wheels commercially with an error in roundness and concentricity of probably not over .002 to .003 in.

The car wheels and axle are driven from the center of the axle by a worm and worm wheel, an opening being left in the revolving journal of the worm wheel and a segment of the worm wheel being removable to admit the axle. In order that the wheels may be held as rigidly as possible, the car wheel revolves on its own journals. Another advantage of this arrangement is that in grinding wheels with flat spots, in many instances the center holes in the axles may have been injured, or the journals may have been worn eccentric with the center holes. The journals rest on a half-bearing at either end, this bearing being composed of lumen bronze and its external surface forming one-half of a sphere, which rests in a pocket corresponding to it. This allows the bearing to adjust itself to a journal that may have been worn slightly tapering. A portion of the bearing is cut away at the bottom, allowing the journal to rest on a small segment of the circle of the bearing on two sides, thus accommodating any variation from standard size of the journal due to wear. The portion of the bearing which is cut away is filled with felt, which is kept saturated with oil, and the journal, pressing this felt as it

revolves, is oiled automatically. The uprights which support the car axle are movable in line with the axle, thus making it possible to grind car wheels having the journals outside of the wheels as well as those having them on the inside.

The grinding wheels have 2¾-in. faces, are 24 ins. in diameter, and the weight of the wheel spindles and slides upon which they are mounted is 1,500 lbs. for each wheel. The slides upon which the grinding wheels are mounted are similar to the ones used on the regular Norton grinding machine. They are mounted on other slides that have a movement parallel with the face of the car wheel, and these are mounted on slide bases which rest upon the base of the machine. The slide base is pivoted, thus making it possible to arrange the traverse of the grinding wheel for a number of different angles of car-wheel faces. The slides operating parallel with the car-wheel face are immersed in oil, in order that there may be no possibility of them roughing up or sticking, due to the fact that they traverse very slowly and have only a comparatively short movement. When once filled with oil they will operate for a very long time without attention, probably for years. The slides traversing parallel with the face of the car wheel are arranged for automatic traverse, although, if necessary, the operator may move them for short distances by means of hand wheels. There is a clutch on either side of the driving gear, one of which is visible in the front view of the machine. The vertical handle shown at the right of this clutch is used for throwing it into engagement. The clutch, when engaged, is automatically locked, and operates a worm which drives a worm wheel mounted on a crank shaft, the shaft moving the slide a distance of 2 ins. Two small handles may be seen, one at the left and one at the right, the one at the right being partly obscured from view by the water hose. The raising of these handles will cause the slides to stop automatically when in the extreme position toward the flange of the car wheel. They are so arranged that the operator cannot stop the traverse of the slide at any other point of the stroke, thus preventing any misunderstanding on his part as to the relation of the grinding wheel and the car wheel flange when he is adjusting the hand wheels.

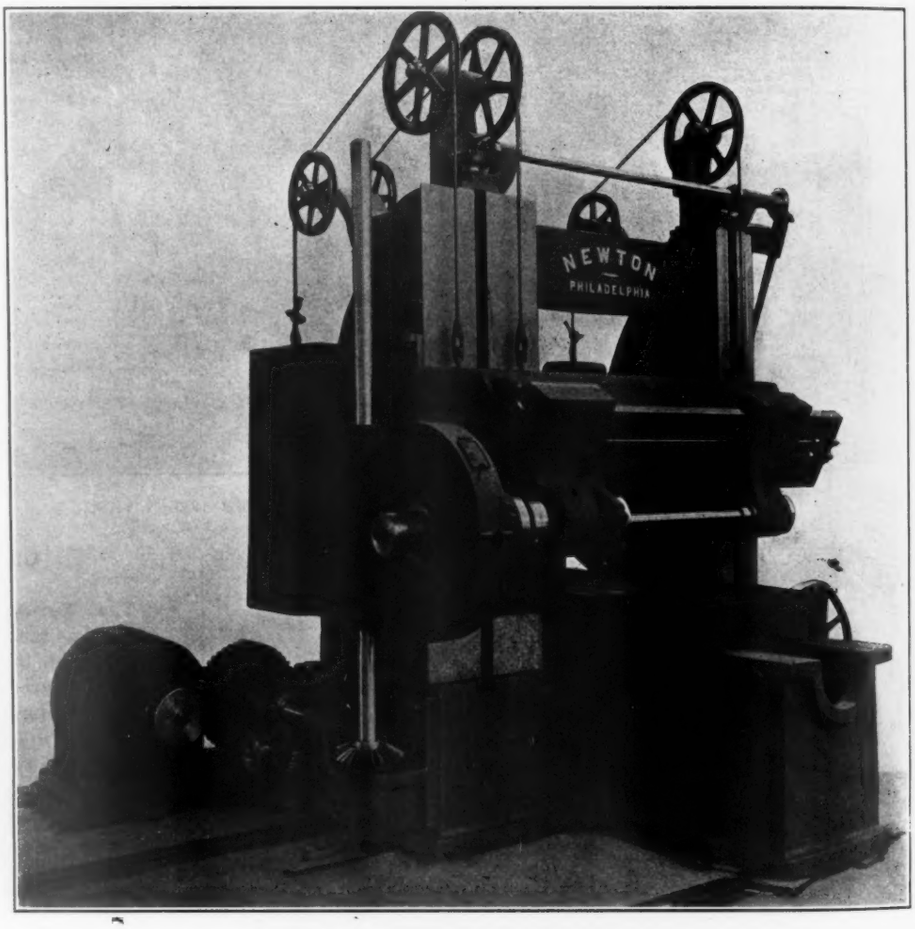
The mechanism for stopping the work revolution is so arranged that the operator can stop the worm and worm wheel at exactly the right position for putting in a car axle. The worms driving the worm wheels are immersed in oil and, as far as possible, all movable parts are covered with heavy guards. The screws for moving the slides, as well as the nuts in which they run, are massive, and every precaution has been taken to produce a machine that will stand very heavy rough usage and at the same time produce very accurate work. The machine weighs complete about 30,000 lbs.

It is arranged with self contained overhead works, permitting the passage of an overhead crane and the lifting of the car wheels and axles in and out of the machine. The machine may be driven either by a belt from a line shaft or by a 30 h.p. constant speed motor. It is provided with a water circulating apparatus having a capacity of 80 gals. per minute, 40 gals. on each wheel. The base of the machine is arranged with a settling tank and with a large water tank in the foundation, from which the machine draws its supply. The settling tank is arranged so that it may be removed by the overhead crane and emptied when necessary.

PLANER TYPE MILLING MACHINE.

The illustration shows an improved design of Newton horizontal slab milling machine of a size especially adapted to railroad shop work. The design and construction are such as to make this machine very rigid and enable it to work the milling cutters to their full capacity. One of these machines, in operation in a locomotive shop, recently removed 18 lbs. from a connecting rod in three minutes.

The table is 30 ins. wide and may be made to mill any desired length. The spindle is 6 ins. in diameter. The cross-rail is of the angular face design, is counterweighted, and may be adjusted either by hand or by power. The spindle is operated by means of a worm and a worm wheel, the worm wheel being of phosphor bronze and the worm of case-hardened steel. The center of the spindle may be raised 32 ins. from the carriage and the uprights will admit work 36 ins. wide. The main upright has a 22-in. face. The carriage is operated by means of a spiral pinion and rack and has nine changes of feed through gearing, with a power quick traverse and hand adjustment. The motor is bolted to an extension of the base of the machine and is a General Electric variable speed 20-h.p. machine, having a speed variation of 2 to 1. The milling machine is made by the Newton Machine Tool Works, Philadelphia, Pa.

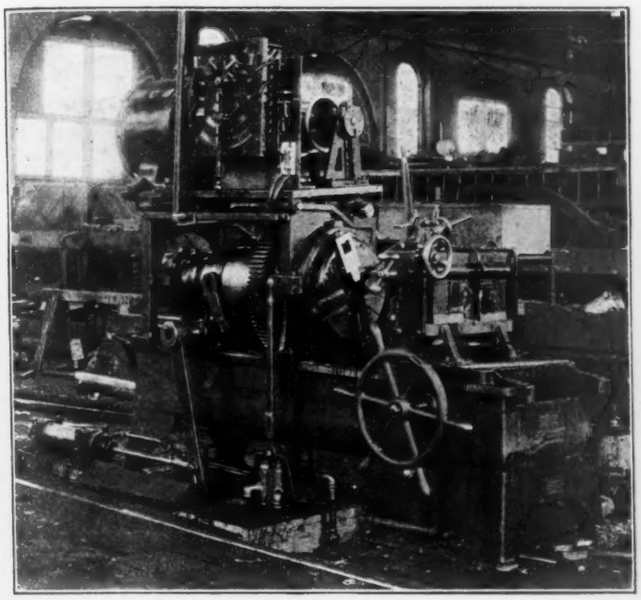


NEWTON PLANER TYPE MILLING MACHINE.

LETTER BALLOT.—The letter ballot of the Master Car Builders' Association resulted in the adoption of all the suggested changes in the standards and rules, except the change in text relating to hand-holds.

INTERESTING ATTACHMENT TO A PIPE MACHINE.

An interesting attachment for operating the gripping chuck of a Bignall & Keeler P. D. Q. C. No. 4 improved pipe threading and cutting machine was recently made and applied at the Burlington shops, Aurora, Ill. The pipe machine was specially designed for use where a number of pieces of pipe of the same size were to be cut and threaded at the same time.



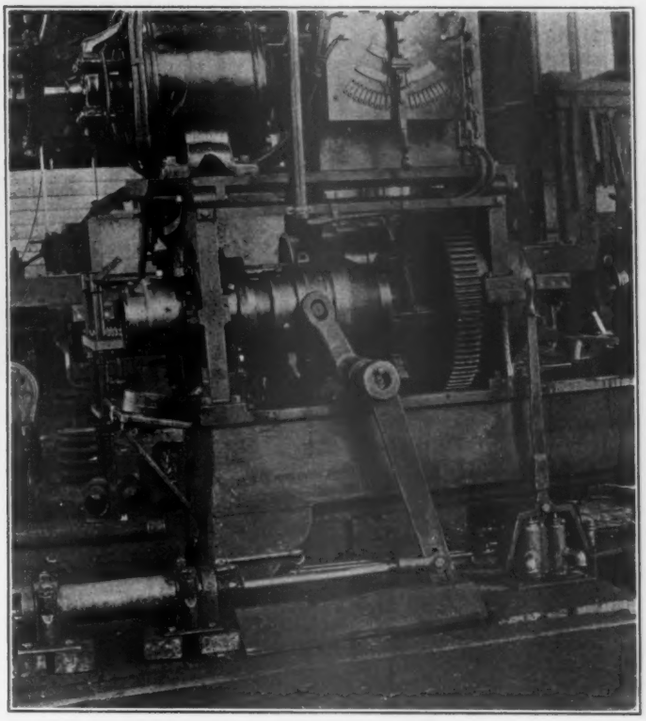
GENERAL VIEW OF PIPE MACHINE.

When the gripping chuck and dies are set for a given size the machine need not be stopped until all the pieces are cut and threaded.

The gripping chuck, as furnished by the builder, was operated by a hand lever, and in order to save time and exertion on the part of the operator a pneumatic device for operating the chuck was applied, as shown on the accompanying illustrations. The hand lever was replaced by the arm which projects downward and is connected to the piston rod. The air cylinder is of brass and was picked up out of the scrap pile; it is 4 ins. in diameter and has a 15-in. stroke. The ¾-in. four-way air valve is larger than necessary, and was designed for another purpose. By pressing down on the treadle air is allowed to enter the cylinder and throw in the clutch. By pushing the lever, which is very easily operated and is convenient to the operator, to the left, the clutch is released. The four-way cock has leather seats, which are perfectly tight, and the greater first cost is more than offset by the saving in air. Springs keep the valves shut against the air pressure, and are so graduated that only a very small prescure on the stem is necessary.

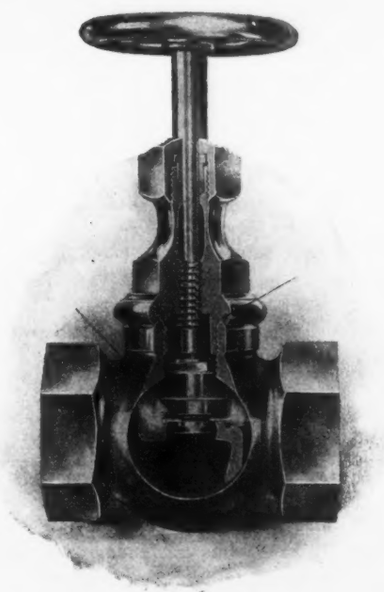
The machine will thread pipe from 1 to 4 ins., and is driven by a 3-h.p., 220-volt direct current Bullock constant speed motor. The motor drives a four-step cone through gearing. The short belt connecting the two cones is tightened by means of cams under the hinged motor table. Eight spindle speeds are available, and the spindle may be reversed by the Cutler-Hammer reversing box.

The machine is equipped with the Peerless die head, which requires but one movement of the lever to set the dies for



PNEUMATIC ATTACHMENT ON PIPE MACHINE.

cutting or to release them so that the pipe may be withdrawn. An automatic oil pump furnishes a continuous supply of oil for the dies and cutting-off tools.

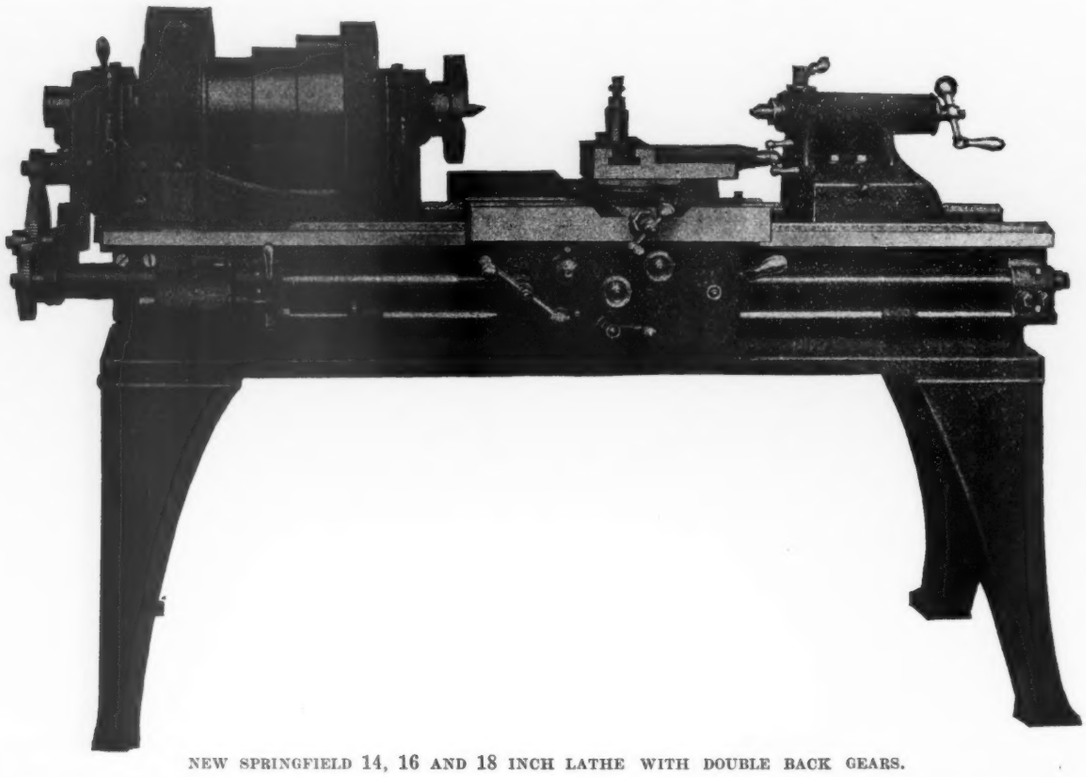


GOLDEN "CLEAN-SEAT" VALVES.

The Golden-Anderson Valve Specialty Company, Fulton Building, Pittsburgh, Pa., has recently brought out a new type of globe and angle valve, which contains a number of excellent features. These valves are made of a heavy pattern, particular attention being given to the diaphragm, making it very rigid so that it will form a square seat for the valve at all times. The special features in which this valve differs from others are found in the construction of the disc and in the joint between the bonnet and the body. The bottom of the disc is hollow, with solid cast eccentric lugs on the side. There is a slot or groove cut through between the lugs and also around the entire outside diameter, and, consequently, in closing the valve when the slot comes flush with the seat, the water, steam or air blows out through the groove across the seat on both the diaphragm and the disc and absolutely cleans them just before the seating of the valve. It will be noticed that there is a projection on the bottom of the valve which acts as the first cut-off or throttle and protects the seat and disc against the disastrous wire-drawing of the steam. This construction is especially important when the valve is cracked or slightly open as at that time the steam escapes through

the hollow disc and the groove without any injury to the seat. The valve is so constructed that it can be packed when open since the back of the valve disc is flat and comes to a seat on the bottom of the bonnet. The valve seat is flat and narrow. It will be noticed that the joint between the bonnet and body is made with a bevel joint and that the threaded part is extra long, thus forming an absolutely tight connection at this point. These valves are made in different sizes for steam pressures up to 600 lbs. and for hydraulic or air pressure up to 2,500 lbs. They are made with both screwed and flanged ends up to 3 ins. in diameter.

The same company also make a boiler blow-off valve which contains the same special features. In that case, however, the body of the valve being of iron or steel is fitted with renewable bronze seats and bronze discs.



NEW SPRINGFIELD 14, 16 AND 18 INCH LATHE WITH DOUBLE BACK GEARS.

NEW SPRINGFIELD ENGINE LATHE.

A new line of standard engine lathes, 14, 16 and 18 ins., equipped with three-step cones and double back gears, thus furnishing eighteen different spindle speeds in connection with a two-speed countershaft, and making it possible to use exceptionally wide belts for lathes of these sizes, has recently been placed on the market by The Springfield Machine Tool Company, Springfield, Ohio. The back gear ratios are 3 to 1 and 9½ to 1, and this, with a 3¼-in. belt on the 16-in. lathe and a 3¾-in. belt on the 18-in., furnishes sufficient power to take care of the heaviest work within the range of these machines. The wide range of spindle speeds, a convenient feed arrangement and the powerful drive make it possible to turn out quickly and accurately either light or heavy work.

The spindles are of large diameter, and are equipped with ring oil bearings, which may be replaced with new ones in case of accidental damage and still maintain the original alignment of the spindle. The spindles have large holes (1 9-16 ins. on the 18-in lathe) throughout their entire length, making it possible to operate on long bars.

The feeds are geared and so arranged that any one of the six changes, from the coarsest to the finest, may be obtained instantly. If the range of feeds within the feed box is not great enough a change of gears on the lead screw will furnish an additional six feeds. If desired, the lathes may be furnished with the Ideal rapid change gear device, an oil pan and a tank and pump. The net weight of the 18-in. lathe with a 6-ft. bed, taking 2 ft. between centers, is 2,600 lbs., while the corresponding weights for the 16 and 14-in. lathes are 2,100 and 1,600 lbs., respectively.

MASTER BLACKSMITHS' ASSOCIATION.—The following officers have been elected by the International Railroad Master Blacksmiths' Association: President, John S. Sullivan, P. R. R., Columbus, Ohio; first vice-president, George H. Judy, B. & O., Pittsburgh; second vice-president, J. W. Russell, P. R. R., Renova, Pa.; secretary-treasurer, A. L. Woodworth, C., H. & D., Lima, Ohio; chemist, George H. Williams, B. M. Jones & Company, Medford, Mass. The 1907 convention will be held in Montreal, Canada.

MASTER MECHANICS' LETTER BALLOT.—As a result of the letter ballot of the Master Mechanics' Association the specifications for foundry pig iron, the specifications for cylinder castings, etc., and the fittings for lubrication were adopted as standard.

PERSONALS.

Mr. Daniel P. Tait, foreman of the Steubenville, Ohio, shops of the Pennsylvania Lines West, is dead.

Mr. T. Harris has been appointed divisional car foreman of the Canadian Pacific Railway at North Bay, Ont.

Mr. A. L. Graburn, superintendent of shops of the Great Northern Railway at St. Cloud, Minn., has resigned.

Mr. H. C. Gribben has resigned as general foreman of shops of the Alabama Great Southern Railroad at Birmingham, Ala.

Mr. C. S. Mills has been appointed master mechanic of the Buffalo & Susquehanna Railway, with headquarters at Galeton, Pa.

Mr. C. R. Williams, general master mechanic of the Buffalo & Susquehanna Railway, has resigned, and the position is abolished.

Mr. W. D. Cox has been appointed general foreman of the Lake Shore & Michigan Southern Railway at Air Line Junction, Ohio.

Mr. R. Breese, machine shop foreman of the Pennsylvania Lines West, at Fort Wayne, has been appointed assistant master mechanic.

Mr. George Thomson has been appointed assistant general foreman of the Lake Shore & Michigan Southern Railway at Collinwood, Ohio.

Mr. T. F. Dreyfus has been appointed superintendent of motive power of the Buffalo & Susquehanna Railway, with headquarters at Galeton, Pa.

Mr. Charles T. Bayless, for the last five years mechanical engineer of the Mexican Central Railroad, died at his home in Aguascalientes, Mexico.

Mr. E. F. Flory has been appointed general foreman of shops of the Lehigh & New England Railroad at Pen Argyl in place of Mr. H. L. Wren, resigned.

Mr. C. B. Smith, heretofore division master mechanic of the Boston & Maine Railroad, has been promoted to mechanical engineer, with office at Boston, Mass.

Mr. R. L. Wyman has been appointed master mechanic of the Lehigh & New England Railroad, with office at Pen Argyl, Pa., vice Mr. F. S. Anthony, resigned.

Mr. A. H. Gairns has been appointed master mechanic of the Denver & Rio Grande Railroad, with office at Grand Junction, Colo., vice J. W. Hardy, resigned.

Mr. E. E. Turney, formerly with the Pere Marquette, has been appointed master car builder of the Cincinnati, Hamilton & Dayton Railway shops at Lima, Ohio.

Mr. Walter Johnson, assistant engine-house foreman of the Pennsylvania Lines West, at Fort Wayne, has been appointed machine shop foreman in place of Mr. Breese.

Mr. W. G. Edgar has been appointed master mechanic of the St. Louis, Iron Mountain & Southern Railway at Helena, Ark., in place of Mr. J. A. Greenoe, resigned.

Mr. J. F. Leak has been appointed master car builder for the Southern Railway at Knoxville, succeeding Mr. J. W. Armstrong, transferred to the shops at Memphis.

Mr. H. E. Culbertson has been appointed master mechanic of the McCook Division of the Chicago, Burlington & Quincy Railway at McCook, Neb., in place of Mr. Kennedy.

Mr. Cassius Brady, formerly engineer of tests of the Great Northern Railway, has been appointed mechanical engineer of the Texas & Pacific Railway, at Marshall, Texas.

Mr. G. C. Johnson has been appointed master mechanic of the Lincoln Division of the Chicago, Burlington & Quincy Railway, with office at Lincoln, in place of Mr. Dietrich.

Mr. Henry Carrick, district foreman of the Oregon Short Line at Montpelier, Idaho, has been appointed division master mechanic at Pocatello, Idaho, succeeding Mr. W. J. Tollerton, resigned.

Mr. J. C. Little, chief draftsman of the Louisville & Nashville R. R. at Louisville, has been appointed mechanical engineer of the Chicago & Northwestern Railroad at Chicago, Ill.

Mr. F. C. Lindt, general foreman of shops of the Great Northern Railway at McCloud, Minn., has been appointed superintendent of shops at that place, succeeding Mr. A. L. Graburn, resigned.

Mr. F. Cochran has been appointed general foreman of the car department of the Lake Erie & Western Railroad at Toledo, Ohio, in place of Mr. George W. Deibert, who has been transferred to Peru, Ind.

Mr. D. J. Durrell, assistant engineer of motive power of the Pennsylvania Lines West at Columbus, has been transferred to Cincinnati, succeeding Mr. P. T. Dunn as general foreman of locomotive and car repairs.

Mr. J. W. Evans has been appointed master mechanic of the Alabama Great Southern Railroad at Birmingham, Ala., succeeding Mr. W. H. Dooley, who has been appointed superintendent of the Ferguson shops.

Mr. F. E. Kennedy, master mechanic of the Chicago, Burlington & Quincy Railway at McCook, Neb., has been transferred to Sheridan, Wyo., as master mechanic of the Sheridan Division, succeeding Mr. Johnson.

Mr. Dennison Gallaudet, general foreman of the Glenwood shops of the Baltimore & Ohio Railroad, has been appointed master mechanic of the Chicago Division at Garrett, Ind., to succeed Mr. J. E. Davis, resigned.

Mr. A. S. McFarland, general foreman of the Southern Indiana at Terre Haute, Ind., has been appointed general foreman of the Missouri Pacific Railway at Wichita, Kan., vice Mr. Frank M. Spangler, resigned.

Mr. W. J. Haskin, heretofore general master mechanic of the Chicago & Eastern Illinois Railroad, has been appointed assistant superintendent of machinery of the Missouri Pacific Railway, with headquarters at St. Louis, Mo.

Mr. T. O. Sechrist, general foreman of the Cincinnati, New Orleans & Texas Pacific at Somerset, Ky., has been appointed master mechanic of the Alabama Great Southern Railroad at Chattanooga, Tenn., succeeding Mr. Evans.

Mr. J. Dietrich, heretofore master mechanic of the Chicago, Burlington & Quincy Railway at Lincoln, Neb., has been appointed assistant superintendent of the lines west of the Missouri River, with headquarters at Lincoln.

Mr. W. Moir, general master mechanic of the Northern Pacific Railway, with office at Tacoma, Wash., has been appointed acting mechanical superintendent, with headquarters at St. Paul, Minn., succeeding Mr. D. Van Alstyne, resigned.

Mr. David Anderson, formerly general foreman of the locomotive and car department of the Indiana Harbor Railroad at Indiana Harbor, Ind., has been appointed general foreman of the Harvey Foundry & Machine Company at Harvey, Ill.

Mr. C. D. Young, assistant master mechanic, Pennsylvania Lines, Northwest system, at Fort Wayne, Ind., has been appointed assistant engineer of motive power, Southwest system, with office at Columbus, Ohio, to succeed Mr. Durrell.

Mr. T. H. Goodnow has been appointed master car builder of the Michigan Southern Division of the Lake Shore & Michigan Southern Railway, excluding Toledo and Air Line Junction, with office at Englewood, Ill., to succeed Mr. Downing.

Mr. L. F. Johnson, assistant master mechanic of the Pennsylvania Lines at Allegheny, Pa., has been appointed general foreman of the motive power department of the Toledo Division at Toledo, Ohio, in place of Mr. T. F. Dreyfus.

Mr. P. T. Dunn, general foreman of locomotive and car repairs of the Pennsylvania Lines West at Cincinnati, Ohio, has been apppointed master mechanic of the Chicago terminal division, with office at Chicago, to succeed Mr. N. M. Loney, resigned.

Mr. M. J. McGaw, master mechanic of the Missouri Pacific Railway at Fort Scott, Kan., has been transferred to St. Louis, Mo., in a similar capacity, succeeding Mr. L. Bartlett, retired. Mr. M. C. Walsh has been appointed to succeed Mr. McGaw at Fort Scott.

Mr. W. C. A. Henry, heretofore assistant superintendent of motive power of the Southwest system of the Pennsylvania Lines, has been appointed superintendent of motive power of that system, with headquarters at Columbus, Ohio, succeeding M. Dunn, deceased.

Mr. W. J. Schlacks, superintendent of machinery of the Colorado Midland Railroad, has resigned to take the management of the central department of a Chicago wholesale manufacturer of railroad supplies, with headquarters in Chicago.

Mr. W. R. Wilson has been appointed to succeed Mr. Thomson as division general foreman of the Michigan Southern Division of the Lake Shore & Michigan Southern Railway, with jurisdiction over LaPorte and all points east on main line and branches, with headquarters at Elkhart, Ind.

Mr. George Thomson, heretofore division general foreman of the Lake Shore & Michigan Southern Railway at Elkhart, Ind., has been appointed division general foreman of that road, the Lake Erie, Alliance & Wheeling and the Dunkirk, Allegheny Valley & Pittsburgh, with office at Collinwood, Ohio, vice Mr. John McCabe, transferred.

Mr. Ira S. Downing has been appointed master car builder of the Lake Shore Division of the Lake Shore & Michigan Southern Railway, including Toledo and Air Line Junction, and of the Lake Erie, Alliance & Wheeling and Dunkirk, Allegheny Valley & Pittsburgh roads, with headquarters at Collinwood, Ohio, vice Mr. Joseph Chidley, who will devote his entire time to locomotive department work.

Mr. Tracy Lyon has resigned as assistant general manager of the Chicago & Great Western Railway to accept a position with the Westinghouse Electric & Mfg. Company. Mr. Lyons was born in Oswego, N. Y., in 1865, and is a graduate of the Massachusetts Institute of Technology. Upon graduation he was a member of the firm of Robert Bement & Company, engineers and contractors of St. Paul. He remained with them until 1894, at which time he was appointed master mechanic of the Chicago Great Western Railway, where he remained for five years. From July, 1899, to March, 1902, he was general superintendent of the same road, and from the latter date until the present time has been assistant general manager. Mr. Lyon is a member of the American Society of Mechanical Engineers.

Mr. David VanAlstyne has resigned as mechanical superintendent of the Northern Pacific Railway to go with the American Locomotive Company. Mr. VanAlstyne was born on June 14, 1865, at Louisville, Ky., and was educated at the Massachusetts Institute of Technology, graduating in 1886. He entered railroad service in that year as machinist apprentice on the Louisville & Nashville Railroad, remaining with that road for eight years, rising to roundhouse foreman. He then spent three and a half years in the foundry business; one year as master mechanic of the Louisville, Henderson & St. Louis Railway; six months as master mechanic of the Great Western Railway, rising to superintendent of motive power of the same road, where he remained from 1899 to May, 1904, at which time he was appointed mechanical superintenedent of the Northern Pacific Railway, which position he held up to the present time.

BOOKS.

Wiring a House. By Herbert Pratt. Published by The Derry-Collard Company, 109 Liberty Street, New York. 19 pages, 6 illustrations. Price, $.25.

This is No. 6 of a series of practical papers. It explains carefully and simply the various steps in the wiring of a modern home.

Brazing and Soldering. By James F. Hobart. Published by The Derry-Collard Company, 109 Liberty Street, New York. 53 pages, 16 illustrations. Price, $.25.

This is No. 5 of a series of practical papers, published by the above company. It gives complete instructions for all kinds of hard and soft soldering; shows what tools to use, how to make them and how to use them.

American Steel Worker. Second Edition. By E. R. Markham. 366 pages, 163 illustrations. Cloth. Published by the Derry-Collard Company, N. Y. Price, $2.50.

This is the second edition of this well-known and excellent book, and has been carefully revised and enlarged by the author. A chapter on high speed steel, which gives the latest information on this important subject, has been added. The book considers the handling and use of tool steels in the most careful manner, and since it is written by a practical man, who has had an experience in this line covering more than 25 years, it is full of most valuable information for the tool users as well as the toolmakers. In view of the present vital importance of maintaining the tools on a par with the modern machines this book will be found to be a valuable aid for all toolmakers and users.

Cincinnati, Hamilton & Dayton Railway Shops at Ivorydale, Ohio. A pamphlet published by The Arnold Company, 181 La Salle Street, Chicago, Ill.

These shops are near Cincinnati and provide facilities for taking care of locomotives lying over at Cincinnati between trips and for making light running repairs to the locomotives and cars operating on the division. The engine house, 254 by 90 ft., of the rectangular type, is served by a transfer table, and contains fourteen tracks on 18-ft. centers. The building is of reinforced concrete and hollow partition tile, the Kahn system being used for beams and roof slabs. On the opposite side of the transfer table is the erecting and boiler shop, 201 ft. by 123 ft. of steel and brick construction. The smith shop and power plant are included in an extension to this shop. The oil house is of reinforced concrete construction.

The other buildings are of brick and wood construction. The pamphlet presents a very complete description of the various buildings and their equipment, the plans and specifications for which, with the exception of the coaling station, installed by Fairbanks, Morse & Company, of Chicago, were prepared by The Arnold Company. The work was also done under their general supervision. A considerable portion of the pamphlet is devoted to an interesting description of the manner in which a piece of work of the kind is handled by The Arnold Company.

CATALOGS.

IN WRITING FOR THESE CATALOGS PLEASE MENTION THIS PAPER.

McCord Draft Gear.—McCord & Company, Chicago, is issuing a catalog which illustrates and describes very completely the new design of draft gear recently perfected by them, which was illustrated in the American Engineer and Railroad Journal, July, 1906, page 274.

Reflection of a Rambler.—This is the title of a booklet being sent out by the Warner & Swasey Company, Cleveland, and contains a very pleasing little story which illustrates the pleasure and profit that can be obtained through the possession and use of a prism binocular. This instrument is very powerful and is manufactured in exceedingly small, compact designs.

Rock Drills.—The Ingersoll-Rand Company, 11 Broadway, New York City, is issuing an attractive catalog, containing many illustrations showing the details of construction and methods of operation of different types of rock drills manufactured by it. These drills contain the latest developments and refinements, and many new features both in construction and arrangement are shown.

Valve Specialties.—The Golden-Anderson Valve Specialty Company, Pittsburg, Pa., is issuing a leaflet which illustrates and describes several types of special valves for railroad use, some of which

are of the new "clean seat" type which design will keep both the disc and the valve seat perfectly clean; a balanced plug valve with a roller lock, a cushion non-return valve, which will equalize between different units of battery of boilers and a tilting steam trap, etc.

THE OIL PROBLEM.—S. F. Bowser and Company, Fort Wayne, Ind., is issuing a leaflet which describes the many advantages of their system of handling oils and illustrates a well designed and equipped oil house on one of the large railroad systems. This company furnishes the tanks, self-measuring pumps and all other apparatus needed to equip a modern railroad oil house.

COMMERCIAL LIGHTING OF INDUSTRIAL PLANTS.—The Cooper-Hewitt Lamp Company, Pittsburg, Pa., is issuing a nicely illustrated pamphlet which gives some very valuable suggestions in connection with the efficient and satisfactory lighting of industrial plants, both as to offices and shops. The subject is of sufficient importance to deserve careful attention, and the pamphlet contains some very useful suggestions.

ELECTRICAL EQUIPMENT.—The General Electric Company, Schenectady, N. Y., is issuing a large number of new bulletins and flyers arranged for binding in their loose leaf binder, several of which will be of interest to motive power men. These include instructive and interesting matter on single phase motors, railway motors, generators, arc and incandescent lamps, switches, multiple unit control, etc. Indexes to the previous issues can also be obtained.

CAR AND TRUCK ORDER GUIDE.—The J. G. Brill Company, Philadelphia, is issuing a large order guide which shows illustrations of its different designs of car trucks, brake rigging and special body features, with each part numbered and accompanied by a list giving the proper name for that part. This order guide will be found to be of value not only in ordering the special parts, but also as reference for the proper names of parts of street car bodies and trucks.

CAST IRON PULLEYS.—The George V. Cresson Company, Philadelphia, is issuing a very complete catalog of cast iron pulleys in all shapes and sizes. Each design is illustrated and accompanied by a table of prices and sizes. Several other specialties are also included in the catalog, including oiling arrangements for pulleys; a patent loose pulley arrangement, which offers several features of advantage; a pneumatic pulley, which will increase the power transmitted by the belt, etc.

PUNCHING AND SHEARING MACHINES.—The Cincinnati Punch & Shear Company, Cincinnati, Ohio, has issued Catalog No. 10, describing their line of punching and shearing machines, bending and straightening rolls and plate doublers. These may be arranged for belt, motor or engine drive. The punching and shearing machines are equipped with the patent positive, adjustable, automatic stop and sliding clutch on angular shaft, which were described on page 65 of our February, 1905, issue.

RAILROAD HYDRAULIC TOOLS.—The Watson-Stillman Company, New York, is issuing catalog No. 69, which shows a very complete line of hydraulic tools for railroad use, including jacks in many different designs and sizes, both plain and telescopic; hydraulic screw punches, both portable and stationary; rail benders, crank pin presses in portable designs, both hand and motor driven wheel presses, portable bushing and shaft straightening presses, as well as specialties in connection with hydraulic tools. New features are noticed in many of these tools.

WATER TANKS AND SUBSTRUCTURES.—The Flint & Walling Manufacturing Company, Kendallville, Ind., is issuing Catalog No. 47, which describes and illustrates the details of the water tanks and superstructures manufactured by them. The illustrations and line drawings show a large number of recent installations furnished by this company, covering many different sizes of tanks arranged for various heads of pressure. As an example, one shows a tank of 100,000 gal. capacity on a superstructure 85 ft. high. Illustrations showing the details used in these tanks are also given. This subject is of particular interest because of the advantages it offers in reducing the cost of insurance.

RADIAL DRILLS.—The 1906 radial drill catalog from The Bickford Drill & Tool Company, Cincinnati, Ohio, has been received. It describes and illustrates the different lines of radial drills manufactured by them, including the 2½, 3 and 3½-ft. radials, fitted with gear drive and box, swinging or swiveling and round tables; their standard radial drills, Nos. 1, 2 and 3; their improved radial drills, Nos. 1, 2 and 3; plain and back-geared semi-radial drills, plain and adjustable wall radials and radials with round, fan-shaped, double-end and double column bases. A number of different arrangements for attaching motors are shown, also the Norris high speed attachment and a special tapping hood.

FEED WATER HEATERS.—Warren Webster & Company, Camden, N. J., is issuing Appendix No. 6 to Part I. of their general catalog, which carefully explains the principle and operation of the Webster feed water heater, purifier, filter and receiver, which is entitled the "Star Vacuum." The catalog is illustrated in a manner which clearly explains the construction of the different parts. The same company is also issuing a pamphlet containing a paper on "Some Phases of the Feed Water Heater Problem," by Walter E. Harrington, which is reprinted from the Street Railway Journal of July 22, 1905. This paper carefully explains the requirements of a successful feed water heater, its advantages and discusses a number of the special features.

BULL DOG OF DRAFT GEARS.—The Farlow Draft Gear Company, Baltimore, Md., is issuing a pamphlet showing some most interesting illustrations of a completely wrecked coal car having steel center sills, which was equipped with Farlow draft gear. This car was so badly wrecked that the center sills were bent double upon themselves and the body was entirely destroyed. The coupler shank was badly bent, but the draft gear was not injured in the least. All parts, except the spring, which had a ⅛-in. set, were ready for use immediately. The illustrations are most interesting and instructive, and show the gear underwent the most severe test imaginable. This book will be of interest to all motive power men.

FIREPROOF PAINT.—The Joseph Dixon Crucible Company, Jersey City, is issuing a pamphlet entitled "Through 'Frisco's Furnace," which contains a number of excellent illustrations showing the different buildings in the city after the earthquake and fire of April 18, 1906. These are for the purpose of ilustrating the protective qualities of Dixon's Silica-Graphite Paint when applied to steel work. They are accompanied by letters from achitects, who have examined the ruins and testify very strongly to the good protection afforded the steel work of many of the buildings by this paint. The same company is also issuing a small booklet descriptive of Dixon's Graphite Brushes for use on electric motors and dynamos. These brushes show to particular advantage in connection with high voltage, are self-lubricating and are the least harmful to the commutator.

PORTABLE TOOLS, ETC.—The Quincy, Manchester, Sargent Company, Old Colony Building, Chicago, Ill., is issuing a loose leaf binder, containing a number of articles descriptive of the line of material now being handled by that company. It is so arranged as to allow of the insertion of new or extra sheets, as changes are made in the design of the machine or new sizes and arrangements added. An index is included which will be corrected as occasion demands. The machines shown include metal sawing machines in many different sizes and arrangements, portable rail saws, portable cylinder boring bar, valve seat planing machine, portable crank pin turning machine, planer chucks, radius planer attachment, flue welder and cleaner, car wheel grinding machine, multiple drills, pneumatic cranes and hoists, both jib and trolley, riveting machinery of all kinds, elastic nuts, car and engine replacers, Ajax diaphragm, Priest snow flanger, brake shoe keys, Globe ventilators, rail benders and Stanwood steps.

ATLANTIC TYPE PASSENGER LOCOMOTIVES.—The American Locomotive Company has issued a new catalog on the subject of Atlantic Type Passenger Locomotives, being the second of a series of catalog pamphlets illustrating and describing their designs. The usual style of catalog pamphlets adopted by this company is followed in this case, beginning wth a description of the Atlantic Type locomotive and presenting the advantages which the type offers for fast passenger service. All of the designs presented in the book, to the number of twenty-six are illustrated with half-tone engravings, each engraving being accompanied by a table giving the leading dimensions of the design. The pamphlet also presents the chief dimensions of each design in tabular form, arranged in the order of the total weights of the locomotives. Railroad officials will find this arrangement very convenient in deciding upon the type and design of locomotives for any special conditions. It is understood that this series of pamphlets will ultimately cover the entire product of these builders.

HIGH DUTY METAL.—The Western Tube Company, Kewanee, Ill., is using a pamphlet descriptive of some researches and experiments which it has recently made in attempting to find a bronze mixture, for use in valves and pipe fittings, which will

maintain its strength under very high temperatures. These experiments were very interesting and showed that the ordinary metal used for this purpose gave a drop in tensile strength of as much as 28 per cent. when raised to a temperature of 407 deg. Fahr., which is about the temperature of steam under 250 lbs. pressure. A number of other alloys were tested, with the final result of obtaining a metal which has been called a "high duty metal," which, when raised to a temperature of 407 deg. Fahr., shows a loss in tensile strength of only 5.6 per cent., giving an ultimate strength at that point of 31,627 lbs. per sq. in. Other tests with this metal showed that its wearing qualities were exceedingly good and that it was very tough and was able to resist shocks with much success. This company proposes to use this metal hereafter for their entire line of brass valves designed for pressures between 125 and 250 lbs., and will, if desired, furnish any of their products in this metal. The pamphlet contains an account of the tests and their results.

STATUE OF MATTHIAS W. BALDWIN.—A bronze statue of Matthias W. Baldwin has been placed on a pedestal in a small park facing the office building of the Baldwin Locomotive Works, at the intersection of Broad and Spring Garden Streets, Philadelphia, and was presented to the city through the Fairmount Park Art Association, with proper ceremonies, on June 2, 1905. The statue, which is of bronze and rests on a granite pedestal, is the work of Mr. Herbert M. Adams, of New York. The side of the pedestal facing Broad Street shows only the name "Baldwin," but on the opposite side is found the following inscription: "Matthias William Baldwin, MDCCXVI—MDCCCLXVI, founder of the Baldwin Locomotive Works. His skill in the mechanic arts, his faithful discharge of the duties of citizenship, his broad philanthropy and unfailing benevolence and his devotion to all Christian work placed him foremost among the makers of Philadelphia."

The statue was raised into place on April 17th, 1906, by a number of men selected from the 50 persons now employed in the works who date their employment or apprenticeship back to Baldwin's time. The ceremony of unveiling, on June 2, included addresses by Mr. John H. Converse, of the Baldwin Locomotive Works; Mr. L. W. Miller, secretary of the Fairmount Park Art Association, and Mayor Weaver, of Philadelphia, all of whom testified to the appropriateness of the inscription on the pedestal. The Baldwin Locomotive Works has issued Record No. 58, which includes a number of illustrations showing the statue and ceremonies and a complete transcript of the addresses delivered on that auspicious occasion.

NOTES.

KOBBE COMPANY.—This company has removed its general offices and works from Trumansburg, N. Y., to Ithaca, N. Y. Their New York office is located at 90-92 W. Broadway.

ROUND HOUSE HEATING.—The new twelve stall round-house for the Southern Railway Company at Ashville, N. C., is to be equipped with a complete heating system by the B. F. Sturtevant Company, of Boston, Mass.

WEIR FROG COMPANY.—Mr. Charles Partington, vice-president and manager of the Weir Frog Company, Cincinnati, O., has resigned and the management is now in the hands of Mr. W. W. Allen, formerly connected with the Ramapo Iron Works.

INDEPENDENT PNEUMATIC TOOL COMPANY.—Messrs. Lake, Hale & Company, 11 Front Street, San Francisco, Cal., have been appointed the exclusive Pacific Coast representatives of this company and will carry a large stock of the Thor pneumatic tools.

BOSTON BELTING COMPANY.—Mr. George H. Forsyth, who has been connected with this company for more than a quarter of a century as salesman, director and assistant manager, died on September 6, 1906, at the age of 52 years at his home in Brookline, Mass, after an illness of over two and a half years.

CHICAGO PNEUMATIC TOOL COMPANY.—Owing to the rapidly increasing demand for its products throughout the Southern States, the Chicago Pneumatic Tool Company has opened an office at 1012 Memphis Trust Building, Memphis, Tenn., which will be in charge of Mr. J. Francis Small. This company reports that during the month of August it did the heaviest business in its history, shipments alone exceeding all previous monthly records by 15 per cent.

RAILWAY EDUCATION.—The fall term of the evening courses in railway education of the University of Chicago opened on October 1st. These courses, of which there are a large number covering all different departments of railroading, occupy one evening a week from October to April inclusive. A fee of $25 is charged for each course. Circulars of complete information can be obtained from the Secretary of Courses in Railroad Education, 422 Grand Central Station, Chicago, Ill.

A JOURNAL OF INDUSTRIAL OPPORTUNITIES.—The Machine Tool Pocket List, formerly published by Angus Ballard Company, has been purchased by the George H. Gibson Company, advertising engineers, Park Row Building, New York City. The size of the book will be increased to 4 x 9 ins., and the Buyers' Finding List of Machine Tools and Supplies will be enlarged and improved. The List will be published with "Manufacturing," a journal in which important patents and other industrial opportunities are described and listed. Brief articles to the manufacturers of machinery will be found in each issue.

AMERICAN LOCOMOTIVE COMPANY.—The fifth annual report of this company shows that the gross earnings for the last fiscal year were over 42½ million dollars, an increase of 18 million dollars over the previous year. The net earnings were nearly 6½ million dollars, an increase of over two million dollars. During the year over one million dollars was expended for additions and betterments of plants and two million dollars was set aside for an extraordinary improvement and betterment fund. Seven per cent. was paid on the preferred stock and 1¼ per cent. on the common stock, leaving a surplus of over one million dollars, an increase of one-half million over last year. During the year a subsidiary company, known as the American Locomotive Automobile Company was organized and Mr. Herman F. Ball has been secured as vice-president and is in charge of its operation. An excellent automobile plant has been constructed at Providence, R. I. A plant for the building of the Atlantic steam shovels has been erected at Richmond, Va.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY.—The report of the board of directors to the stockholders of this company covering a period of six years, which was recently issued, contains some very interesting figures and information. The total number of employees exclusive of the selling organization has increased from less than 8,000 in 1901 to nearly 15,000 in 1906. The number of men employed in the engineering department has increased from 420 to 629 in the same period, and by means of better organization, each man handles a larger amount of work than was the case five years ago. The report states that at least 45 per cent. of the engineering force is continually engaged in development work. The report of the sales department shows that the sales of the company have increased from 12½ million dollars in 1901 to nearly 25 million dollars in 1906, with an indication of over 34 million dollars for the current year. This does not include the sales of subsidiary companies. The sales for the electric pneumatic switch system show an increase of 60 per cent. over any previous year; sales of railway motors have increased over 51 per cent. over any previous year. The report states that there are six railways now successfully using the single-phase system, and that the installation of the same system on five other large roads is now in progress. The sales of the detail and supply department has increased over 90 per cent. during the past year. The general balance sheet shows that the value of properties and plants owned is over 11 million dollars and that the surplus is over 11½ million dollars. The gross earnings for the six years were $114,618,537, and the net earnings were over $17,000,000

ELECTRICAL EQUIPMENT FOR THE HUDSON COMPANY'S TUNNELS.—The construction work on the twin tunnels of the Hudson Company, connecting Jersey City with New York under the North River, was finished about a year ago and the work on the electrification is now under way. Fifty electric cars will be operated, taking their power from a third rail. Each tunnel has a single track and the cars will be operated in trains by the Sprague General Electric multiple unit control system. The power station, which will be located on the New Jersey side between Jersey City and Newark, will contain two 3,000 k.w., 11,000 v. generators and two 6,000 k.w., 11,000 v. generators, each being direct connected to Curtis steam turbines. This power will be distributed at high voltage to three sub-stations where the current will be stepped down to 650 volts direct current through transformers and rotary converters. Two of these sub-stations will be located in New York and one in Jersey City. All of the electrical equipment will be furnished by the General Electric Company. The American Locomotive Company will furnish the 50-motor and 50-trailer trucks for the cars, designs of which are now being prepared. Each motor truck will carry two 160-h.p. motors, which will be geared to one wheel on each axle, the wheel hub being extended to take the gear for the motor. Both types of trucks will be of the bar frame, swing bolster design, the bolsters being of rolled steel between transoms of channel iron and sustained by four three-point hangers. This type of suspension will allow the bolsters a good lateral motion and utilize the weight of the truck to restore the hangers to their proper position without the use of springs. The motor trucks will have 34½-in. wheels and 5 x 9½-in. journals. The trailer trucks will have 30-in. wheels and 4¼ x 9½-in. journals.